Appendix 1

Consultation Chronology

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June 4, 1990 - Public Notice of Proposed Reissuance of a NPDES Permit for Potlatch, Lewiston, Idaho.

February 25, 1991 - EPA issued a Total Maximum Daily Load (TMDL) for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) for the Snake and Columbia River system.

February 5, 1992 - EPA requested formal consultation with the FWS regarding the TMDL.

March 6, 1992 - EPA issued a National Pollutant Discharge Elimination System (NPDES) Permit to Potlatch Corporation for discharges from the Lewiston, Idaho Pulp and Paper Mill.

February 18, 1993 - Request for a species list (from EPA) for federally threatened and endangered species within the vicinity of the Potlatch Corporation's discharge was submitted to the FWS and National Marine Fisheries Service (NMFS).

March 18, 1993 - Submission of a species list from the NMFS to EPA for federally threatened and endangered species within the vicinity of the discharge from Potlatch Corporation's Lewiston, Idaho Pulp and Paper Mill.

July 2, 1993 - EPA prepared a Biological Assessment (BA) as part of an informal consultation with NMFS for the effect to certain listed salmonid species from the proposed 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) for the Snake and Columbia River system TMDL.

January 6, 1994 - The FWS submitted a Biological Opinion on the dioxin TMDL for the endangered bald eagle.

September 14, 1994 - A Draft Biological Evaluation for Reissuance of a NPDES permit for the Potlatch Corp., Lewiston, Idaho was prepared by Science Application International Corporation and submitted to EPA.

March 6, 1997 - Request for a species list (from EPA) for federally threatened and endangered species within the vicinity of the discharge from Potlatch Corporation's Lewiston, Idaho Pulp and Paper Mill was submitted to the FWS and NMFS.

June 1997 - Submission of a species list from the Service to EPA for federally threatened and endangered species within the vicinity of the discharge from Potlatch Corporation's Lewiston, Idaho Pulp and Paper Mill.

June 12, 1997 - The NMFS received the Proposed Sampling Plan for the Bioaccumulation Monitoring Program for Fishes in the Lower Granite Reservoir and Vicinity, Snake River, Idaho/Washington.

July 15, 1998 - Meeting in Lewiston, Idaho, between the NMFS, FWS, EPA, Potlatch, The Lands Council, Idaho Rivers United, Idaho Dept. of Environmental Quality, Washington Dept. Of Ecology , and the Nez Perce Tribe to discuss Potlatch's NPDES permitting process and related issues.

September 3, 1998 - The NMFS, jointly with FWS, submitted background materials and information suggestions for preparation of the Biological Assessment to EPA.

October 22, 1998 - Meeting between the NMFS, FWS, EPA, Potlatch, and Ogden Environmental in Spokane, Washington, to discuss ESA consultation issues.

April 12, 1999 - EPA submitted, to the NMFS and FWS, a predecisional draft copy of the NPDES permit for Potlatch Corporation in Lewiston, Idaho.

October 12, 1999 - EPA submitted, to the NMFS and FWS, a draft BA for the NPDES permit for Potlatch Corporation in Lewiston, Idaho.

November 19, 1999- The NMFS received Chapter 4 of the Draft Biological Assessment.

December 13, 1999 - The NMFS received a draft copy of the Potlatch NPDES permit.

January 2000- The NMFS and FWS submitted comments on EPA's draft Biological Assessment.

March 16, 2000 - Meeting between the NMFS, FWS, EPA, Potlatch, and Ogden Environmental in Boise, Idaho, to discuss the Service's and NMFS' comments on the draft BA and other issues pertaining to the consultation process.

April 12, 2000 - Meeting summary (3/00) and schedule for completion of the BA prepared and submitted by EPA.

May 19, 2000 - EPA forwarded (from Stoel Rives) to the NMFS and FWS an Additional Figure (X-43) to the draft steelhead life history section of the Draft BA.

June 7 - 12, 2000 - EPA forwarded (from Stoel Rives) to the NMFS and FWS the Effects of the

Permitted Parameter section of the Draft BA.

June 16 - 21, 2000 - EPA forwarded (from Stoel Rives) to the NMFS and FWS the Effects of the Action section of the Draft BA.

July 25, 2000 - EPA forwarded (from Stoel Rives) to the NMFS and FWS the Temperature Appendix of the Draft BA.

August 14, 2000 - EPA forwarded (from Stoel Rives) to the NMFS and FWS the Draft Biological Oxygen Demand and revised Effects of the Action sections as well as responses to comments on sections of the Draft BA submitted by the FWS on August 3, 2000.

September 1, 2000 - Potlatch submitted revised draft BA to EPA, NMFS and FWS.

November 1, 2000 - EPA submitted the Final BA for reissuance of Potlatch's NPDES permit to the NMFS and FWS.

November 28, 2000 - EPA submitted to the NMFS and FWS a revision to the BA addressing changes in the instantaneous maximum effluent temperature limitation.

July 2, 2001 - The NMFS received two additional reports addressing water quality conditions in the lower Snake River from Stoel Rives.

August 23, 2001 - The NMFS received a copy of a letter from the Land and Water Fund of the Rockies to the U.S. Dept. of Justice regarding potential litigation.

January 15, 2002 - The NMFS received a Notice Of Intent (NOI) to file suit against the FWS and NMFS for failure to issue timely BOs for Potlatch's NPDES permit renewal.

March 2002- The NMFS sent letter to EPA regarding the timeline for completion of formal consultation for Potlatch's final NPDES permit.

March 14, 2002 - The NMFS received a letter from EPA regarding the timeline for completion of formal consultation for Potlatch's final NPDES permit.

March 18, 2002 - letter from Stoel Rives to NMFS and the FWS regarding timeline for completion of formal consultation for Potlatch's final NPDES permit.

April 19, 2002 - letter from NMFS to Stoel Rives regarding NMFS proposed comment periods for review of draft BOs.

February 21, 2003 - National Marine Fisheries Service (now NOAA Fisheries) submitted discussion draft biological opinion to EPA.

March 11, 2003 - NOAA Fisheries and FWS met with EPA in Boise, Idaho, discussing consultation issues and next steps.

June 17-19, 2003 - Technical meeting between Potlatch, EPA, FWS, and NOAA Fisheries in Boise.

June 19, 2003 - EPA released a new draft NPDES for public comment

June 30-July 1, 2003 - Technical meeting between Potlatch, EPA, FWS, and NOAA Fisheries in Seattle.

July 27, 2003 - letter from Don Anderson of NOAA Fisheries and Susan Martin of FWS to Robert Robichaud, EPA, advising EPA's 2000 draft NPDES permit and BA were now withdrawn and EPA's 2003 revised permit and biological assessment constitute a new federal action.

October 30, 2003 - NOAA Fisheries, FWS, EPA, and Potlatch met in Seattle to discuss the Services' comments on the draft biological evaluation.

November 6, 2003 - NOAA Fisheries, FWS, EPA, and Potlatch met in Seattle to discuss outstanding technical issues and the draft biological evaluation.

December 12, 2003 - NOAA Fisheries received the biological evaluation from EPA of their proposed 2003 permit limits.

December 19, 2003 - NOAA Fisheries received a letter from Potlatch committing to and describing additional conservation measures.

March 3, 2004 - NOAA Fisheries received from EPA a letter amending the action and the BE to include Potlatch's conservation measures of December 19, 2003.

March 12, 2004 - NOAA Fisheries provided EPA with a draft biological opinion for review.

March 22, 2004 - EPA and Potlatch provided written and verbal (conference call) comments to NOAA Fisheries on the draft biological opinion.

Appendix 2

Flow Statistics for the Snake and Clearwater Rivers

Appendix 2. Flow Statistics for the Snake and Clearwater Rivers

All flows in cubic feet per second (cfs)		Frequency				Harmonic Mean Flow
Scenario:		**1Q10**	**4B3**	**7Q10**	**30Q5***	
A	**Snake 1/1/1973-12/31/2002**					
1	January	13,311	18,142	15,217	19,953	24,888
2	February	13,689	19,250	15,069	20,669	26,321
3	March	13,725	22,060	16,061	24,464	31,863
4	April	17,019	28,357	19,086	30,710	38,985
5	May	22,470	36,790	25,514	43,382	53,478
6	June	17,978	32,742	20,132	36,496	46,968
7	July	11,114	16,514	12,461	18,337	23,544
8	August	9,968	13,052	10,577	13,256	16,183
9	September	9,693	12,940	11,028	14,663	17,243
10	October	11,820	14,728	12,861	15,818	18,685
11	November	12,800	15,067	13,252	15,679	19,103
12	December	12,658	16,434	13,457	16,985	21,050
B	**Clearwater minus Dworshak 1/1/1973-12/31/2002****					
13	January	0	1,597	1,255	2,396	2,534
14	February	0	2,463	1,587	3,182	3,842
15	March	1,588	4,259	3,096	6,352	6,926
16	April	4,481	7,849	5,748	12,347	12,858
17	May	10,400	14,791	12,176	21,642	23,660
18	June	5,138	9,961	6,074	14,089	16,631
19	July	963	2,635	2,054	4,069	4,715
20	August	0	1,305	938	1,627	1,847
21	September	0	1,182	997	1,439	1,583
22	October	929	1,315	1,025	1,448	1,815
23	November	270	1,481	1,266	2,022	2,158
24	December	156	1,429	1,300	2,042	2,383
C	**Snake and Clearwater (minus Dworshak) 1/1/1973-12/31/2002**					
25	January	14,980	20,763	17,190	22,846	28,672
26	February	15,951	22,748	17,676	24,387	31,251
27	March	17,177	27,170	20,237	31,296	40,078
28	April	22,796	37,389	26,539	44,695	53,998
29	May	35,997	53,764	39,899	66,500	79,357
30	June	24,325	44,104	27,126	51,950	65,332
31	July	13,203	19,541	15,038	22,682	28,786
32	August	10,791	14,695	12,036	15,067	18,345
33	September	10,669	14,478	12,434	16,288	19,136
34	October	13,093	16,363	14,246	17,651	20,825
35	November	14,091	17,111	15,078	18,427	22,204
36	December	13,869	18,864	15,399	19,358	24,439
D	**Clearwater, unmodified, 1993 - 2002**					
37	January	2,277	3,518	2,595	4,478	5,928
38	February	2,863	5,198	3,456	5,528	7,729
39	March	3,574	6,659	4,321	9,214	11,577
40	April	8,212	12,111	9,707	18,199	20,257
41	May	17,746	23,425	21,918	30,514	35,127
42	June	9,173	14,889	10,800	18,869	23,071
43	July	7,689	11,199	9,859	14,866	16,731
44	August	2,659	5,183	3,598	9,284	8,910
45	September	2,443	2,644	2,465	2,976	3,562
46	October	2,359	2,747	2,380	2,866	3,563
47	November	2,228	2,935	2,541	3,263	4,252
48	December	2,363	2,870	2,780	3,363	4,468

Notes:
*28Q5 is presented for February.
**For the Clearwater minus Dworshak data set, zeros were substituted for negative flow values.
Zeros were excluded from harmonic mean calculations

MONTHLY VARIATION SUMMARY FROM CLEARWATER AT SPALDING POR

Post-Dworshak regulation (from water year 1972-present)

Monthly Variation

cfs	peak 100%	99%	95%	90%	75%	50%	25%	20%	10%	5%	1%	0.33%	low 0.11%
Sept	14700	12900	12200	11600	10575	6770	3463	3210	2820	2580	2439	2381	2330
Oct	17100	11842	7682	6193	4840	3960	3220	3110	2869	2728	2393	2360	2300
Nov	61900	25818	14105	12200	9030	5610	3970	3758	3319	3100	2590	2249	2100
Dec	74300	39884	22065	16530	12600	8060	4430	4118	3479	3240	2552	2170	1760
Jan	48700	38963	21000	18690	13500	8495	4460	4168	3471	3032	2412	2273	2070
Feb	88100	43850	29825	23800	15900	9615	5268	4840	3790	3320	2758	2568	2360
Mar	58700	50240	39000	33900	23000	14100	8450	7760	5880	4920	3400	3350	3250
Apr	72600	64484	43200	37800	30100	21100	13400	11800	9601	8118	5549	4335	4060
May	86700	79260	62400	54400	43400	34200	26700	24600	20000	16400	11180	9950	9560
June	124000	79440	61200	55100	42400	28500	18200	15900	10400	8850	5888	5460	5110
July	50400	41080	28600	25500	18200	12700	7670	7000	5420	4620	3658	3177	2930
Aug	28500	25140	19800	16100	11400	5340	3850	3670	3170	2770	2476	2365	2250
Sept	14700	12900	12200	11600	10575	6770	3463	3210	2820	2580	2439	2381	2330
Oct	17100	11842	7682	6193	4840	3960	3220	3110	2869	2728	2393	2360	2300

Median 10,300

MONTHLY VARIATION SUMMARY FROM CLEARWATER AT SPALDING POR

(1973-2002)

Monthly Variation

cfs	peak 100%	99%	95%	90%	75%	50%	25%	20%	10%	5%	1%	0.33%	low 0.11%
Sept	14700	12900	12200	11600	10600	7210	3568	3278	2820	2570	2430	2379	2341
Oct	17100	11900	7720	6240	4935	3990	3265	3130	2890	2810	2400	2380	2360
Nov	61900	26358	14200	12320	9308	5630	4000	3778	3320	3130	2581	2247	2136
Dec	74300	40032	22330	16900	12600	7910	4410	4110	3488	3269	2700	2475	2233
Jan	48700	39507	21055	18700	13700	8715	4530	4270	3559	3190	2523	2293	2089
Feb	88100	43908	29770	23840	15900	9620	5375	4844	3790	3350	2765	2566	2419
Mar	58700	46426	37355	32600	22275	13400	8350	7614	5829	4893	3400	3350	3277
Apr	72600	64603	43500	37800	29900	20750	13175	11580	9476	8059	5538	4327	4123
May	81400	67939	59200	52700	42675	33700	26425	24000	19790	16400	11087	9932	9617
June	124000	77010	60800	54120	41300	28200	18000	15800	10400	8819	5840	5456	5184
July	50400	41297	28300	24630	18100	12550	7613	6874	5359	4620	3649	3173	2945
Aug	28500	25171	20510	16110	11600	5390	3843	3650	3149	2765	2473	2362	2269
Sept	14700	12900	12200	11600	10600	7210	3568	3278	2820	2570	2430	2379	2341
Oct	17100	11900	7720	6240	4935	3990	3265	3130	2890	2810	2400	2380	2360

MONTHLY VARIATION SUMMARY FROM SNAKE AT ANATONE

WY 1973-2002

Monthly Variation

cfs	peak 100%	99%	95%	90%	75%	50%	25%	20%	10%	5%	1%	0.33%	low 0.07%
Sept	38100	36801	28305	26800	23400	18800	14300	13580	11200	10200	9260	8727	8520
Oct	40000	38171	31700	28950	24700	19450	15400	15000	14100	13300	12129	10279	9960
Nov	49800	39200	36805	31410	25125	19400	15800	15380	14299	13800	12999	12500	12200
Dec	92600	50271	39555	36310	29775	23200	16725	16100	14800	13900	13200	12513	11800
Jan	173000	78672	52855	41620	33400	26300	19800	18800	16890	15500	13229	13100	12900
Feb	117000	86210	69710	52300	36850	29500	19950	18500	16300	15200	13900	13500	13500
Mar	104000	98649	85455	75920	55775	35000	23700	21900	18400	16900	15329	14313	12100
Apr	119000	105020	92505	83910	69075	47600	27575	25300	21100	19100	15898	14690	14200
May	177000	147420	125000	109000	87100	63100	43000	40300	30570	25800	18600	17059	15100
June	191000	155010	138000	127000	95925	63550	37100	31900	22100	18090	15200	14997	14700
July	122000	93875	71455	58740	37650	26200	17000	15700	14000	12600	10858	10507	9790
Aug	36200	33313	29100	27200	21700	17000	13325	12700	10980	9865	9433	8778	8700
Sept	38100	36801	28305	26800	23400	18800	14300	13580	11200	10200	9260	8727	8520
Oct	40000	38171	31700	28950	24700	19450	15400	15000	14100	13300	12129	10279	9960

Median 25,700
Median 25,700

Appendix 3.

Potlatch's Proposed Voluntary Mitigation Measures

of

December 19, 2003

December 19, 2003

Mr. Robert Robichaud
Mr. John Palmer
U. S. Environmental Protection Agency
Region 10
1200 6th Avenue
Seattle, WA 98101

Mr. Michael Crouse
Mr. Russ Strach
NOAA Fisheries
Habitat Conservation Division
525 NE Oregon Street, Suite 500
Portland, OR 97232

Ms. Susan Martin
Ms. Toni Davidson
U. S. Fish and Wildlife Service
Upper Columbia Fish and Wildlife Office
11103 East Montgomery Drive
Spokane, WA 99206

Ladies and Gentlemen:

Potlatch Corporation has been working with the Environmental Protection Agency (EPA), NOAA Fisheries (NOAA) and Fish and Wildlife Service (FWS) to address Endangered Species Act issues (ESA) associated with the proposed NPDES permit no. ID00001163 for the Potlatch Lewiston Mill ("proposed permit"). Early this summer, EPA, NOAA, FWS and Potlatch agreed to use the process of collectively developing a biological evaluation of the proposed permit to identify and address ESA issues. Our purpose has been to assure that issuance of the proposed permit will not jeopardize ESA listed species and that concerns over potential adverse effects are appropriately addressed.

Potlatch does not agree with aspects of EPA's *Biological Evaluation of the Potlatch Corporation Pulp and Paper Mill National Pollutant Discharge Elimination System (NPDES) Permit* ("BE"), which found certain substances in the Potlatch mill effluent and regulated by the proposed permit to have adverse effects on listed species. Under separate cover, Potlatch will submit its view of the science underlying these issues. Despite our differing views, we have appreciated the professional manner in which all parties have engaged the issues.

The purpose of this letter is to describe Potlatch's proposed voluntary mitigation measures and their effects on the conditions that led to the EPA's "adverse effect" conclusions. These mitigation measures were referred to in the December 2, 2003 BE, but have since been refined in discussions between Potlatch, EPA and NOAA. This letter first discusses the BE's adverse effect findings, and then describes the refined mitigation measures, and their effects on the species at issue and their critical habitat .

Potlatch's proposed voluntary mitigation measures are designed to reduce the overall amount of pollutants that it has historically discharged to the affected waters. The commitments Potlatch is ready to make will achieve overall pollutant reductions, not just compared to pollutant levels that would otherwise be allowed by the proposed permit. That is, the mitigation measures point to absolute reductions, not just relative reductions.

The letter also describes Potlatch's monitoring proposal, which is designed to narrow uncertainties about the nature and effects of the Potlatch effluent and verify the effects of mitigation measures. This element of the proposal is still under discussion. Thus, we urge EPA to notify NOAA and FWS that EPA is modifying the action proposed in the BE to reflect the measures described in this letter, contingent on EPA's issuance of the NPDES permit proposed in the BE and development of a detailed monitoring program acceptable to Potlatch.

I. Temperature

A. BE finding

The BE considered several temperature issues, including the potential for high summer temperatures to block the adult salmon migration (thermal blockage) and the possibility that temperature differences between the effluent and the ambient river would cause thermal shock. The BE finds thermal shock unlikely, but also finds that Potlatch's discharge results in "some portion of the river with a slight increase in temperature." The BE characterizes the increase as "slight," "small," or "negligible," depending on the month. Because July-September river temperatures are thought to block the adult salmon migration in many years, the BE concludes that even a slight temperature increase from effluent would likely adversely affect salmonids in July-September. The BE reaches this conclusion notwithstanding the BE's own demonstration that the effluent temperature is consistent with benchmarks that were derived from regional temperature guidance criteria that EPA developed in cooperation with NOAA, FWS, Northwest states and tribes.

B. Proposed mitigation

Even though the proposed permit authorizes a bigger mixing zone consistent with applicable water quality standards designed to protect the most sensitive of aquatic biota, Potlatch will voluntarily take steps to reduce any potential for thermal shock and mitigate any contribution to thermal blockage in the summer. Potlatch will assure that its effluent will meet permit temperature limits (32° C in July, 31° C August through September, and 33° C October through June) at the diffuser and, to address any concerns about thermal shock, ensure that effluent temperature will be no more than 1° C above ambient river temperature 10 feet from the diffuser.[1] Potlatch will meet these objectives by taking the following steps:

1. Heat Recovery Projects

Potlatch will complete installation and begin operation of three heat recovery projects by April 1, 2004: 1) foul condensate heat exchanger at no. 4 power boiler, 2) mill water through no. 4 turbine generator condenser, and 3) wood products and Lurgi condensate return. Preliminary estimates of the amount of heat to be recovered when the three projects are in operation are: 1) 40 MMBTUs per day, 2) 100 MMBTUs per day, and 15 MMBTUs per day respectively. Heat recovered within the manufacturing process should reduce the amount of heat discharged to the waste water treatment system. Potlatch will report to EPA (Robert Robichaud), NOAA (David Mabe) and FWS (Susan Martin) in writing by June 30, 2004 regarding the status of these projects. Potlatch may implement these projects before issuance of the subject NPDES permit.

2. Clearwater River augmentation

Upon issuance of the subject NPDES permit, Potlatch will begin installation of facilities to pump Clearwater River water into the discharge pipe that transports effluent from the aerated stabilization basin ("ASB") to the diffuser, as permitted by the pipe's capacity and effluent discharge from the ASB. The discharge pipe has a capacity of approximately 40 million gallons of liquid per day ("mgd"). EPA analysis shows that past effluent discharge volume ranged from 28 mgd to 40 mgd (average 33-34 mgd) (*see* EPA December 8, 2003 analysis). Potlatch will pump not less than one mgd nor more than 10 mgd of Clearwater River water (average 6-7 mgd) into the discharge pipe. Potlatch will pump Clearwater River water into the discharge pipe between May 15 and September 30 annually. This measure requires installation of new pumps, which will be completed not more than nine months after the renewed NPDES permit and other required permits are issued.

3. Operation and Maintenance Activities

Upon issuance of the proposed permit, Potlatch will implement the following measures during the May 15-September 30 time period:

- Manage the foam blanket on the ASB to maximize the pond's ability to shed heat. This will be accomplished by the addition of non-toxic chemical defoamers coupled with the use of sprinklers around the periphery of the ASB.

- Implement an aeration control strategy that maximizes the amount of evaporative heat loss from the ASB.

[1] Temperatures 10 feet from the diffuser would be calculated as shown in EPA's December 8, 2003 calculations, attached hereto as Exhibit A (hereafter "EPA December 8, 2003 analysis").

- Rainbird-style sprinklers - Potlatch will utilize high-volume Rainbird-style sprinklers located around the periphery of the ASB to reduce the temperature of the ASB by evaporative heat loss and dissipate surface foam, reducing the insulating effect of the foam blanket.

C. Temperature reduction effects

To determine the effect of these measures, EPA analyzed Clearwater and Snake River 1994-2002 water temperatures and effluent temperatures leaving the Potlatch ASB. EPA used daily measurements of the effluent temperature at the point where effluent leaves the ASB, and daily temperature and flow rates in the Clearwater and Snake Rivers. The analysis estimated daily effluent temperatures at the Potlatch diffuser after Clearwater River water augmentation and daily effluent temperatures at a distance of 10 feet from the diffuser (*see* EPA December 8, 2003 analysis). These calculations show that even apart from Potlatch heat recovery and operation and maintenance measures, the temperature of effluent leaving the diffuser will be reduced by approximately 3° C on average. This reduction will ensure that Potlatch meets the permit's temperature limits and that the effluent plume will be no more than 1° C above ambient 10 feet out from the diffuser. With further temperature reduction from heat recovery and operation and maintenance measures, which will mitigate any slight contribution to the river's heat load, Potlatch's mitigation measures should achieve temperature objectives with a margin of safety and mitigate effects on listed species.

II. Total Suspended Solids (TSS)

A. BE finding

The BE indicates that TSS likely plays a pivotal role in the adverse effect findings, for several reasons.

- Listed species may be exposed to TSS concentrations above the TSS toxicity benchmark. Thus, the BE finds TSS itself may adversely affect listed species.

- TSS carries certain chlorinated compounds (COPCs) that the BE assumes are in Potlatch effluent, and dioxin and furan (2,3,7,8-TCDD and 2,3,7,8-TCDF). The technical mechanism by which TSS becomes a transportation vehicle for these compounds is "adsorption" – the process by which these compounds attach to organic solid matter in TSS.

- Biological oxygen demand (BOD), chemical oxygen demand (COD) and low levels of dissolved oxygen (DO) in effluent (which the BE finds are likely to adversely affect listed species in the June-November period during the five years period the permit provides for the mill to achieve the new BOD effluent limit) result from TSS in the effluent, organic compounds adsorbed to solid matter, and colloidal organic matter in effluent. A fraction of the total oxygen demand of effluent (contributed by colloidal organic matter) cannot be reduced because it is not bound to solid matter. However, a larger fraction of oxygen demand derives from organic particulate matter and the organic compounds adsorbed to solid matter. TSS in the Mill's effluent is primarily organic because it is comprised largely of the remains of microbes from the ASB.

- TSS is related to turbidity, which causes light to scatter, affecting color. In the Snake River, these effects reduce the depth at which light penetrates and influences photosynthesis.

- TSS is related to AOX. AOX chemical composition varies among mills and even at a given mill over time. Chlorinated compounds, which are carried by TSS in effluent, are an evaluation surrogate for AOX.

- The BE's Whole Effluent Toxicity (WET) finding is based on the effects of individual parameters – chlorinated compounds, dioxin, furan, etc. – for which TSS tends to be the transportation vehicle.

Thus, the BE finds likely adverse effects from TSS itself and from a series of TSS-related compounds and effects. While the extent to which the Mill effluent contains such compounds is in dispute, Potlatch developed mitigation proposals in consultation with the agencies on the hypothesis that TSS reduction will reduce these pollutants if they are present in Potlatch effluent.

B. Proposed mitigation

Potlatch will use the following (or other) measures as needed to reduce TSS by 25% (determined by comparing a 12-month rolling average of the Mill's TSS discharge to 2002 discharge levels). Potlatch will seek to accomplish this goal in the first year of operation under the renewed NPDES permit, but in any case will achieve the goal by the end of three years. Potlatch will:

- Improve capture of TSS in the primary clarifier: Potlatch will operate the mill's primary clarifier dewatering system 24 hours a day, seven days a week to capture and remove more of the solids (TSS) prior to entering the ASB;

- Add a polymer in the primary clarification process to enhance flocculation, thereby capturing TSS and associated pollutants prior to entering the ASB; and

- Adjust nutrients in the ASB to modify ASB biology and reduce TSS and associated pollutants in the effluent discharged from the ASB.

C. TSS reduction effects

Potlatch's commitment to reduce TSS by 25% at the end of three years, if not earlier, is not limited by the above measures. During the first year of operations, Potlatch will evaluate the results of these TSS reduction operations to determine their effectiveness, and will continue these operations for the term of the permit unless the evaluation demonstrates that these measures are ineffective in reducing TSS. If the measures prove ineffective, Potlatch will implement other measures as needed to achieve 25% reduction over three years.

If Potlatch determines that more efficient or effective technologies are available to achieve these objectives in lieu of the methods described above, it will notify NOAA, FWS and EPA and, unless they object, implement such technologies.

In summary, the measures proposed by Potlatch will reduce the mill's effluent temperature to proposed permit limits and will ensure that temperatures 10 feet from the diffuser are no more than 1° C above ambient river temperatures. By reducing TSS in the effluent by 25% within the next three years the proposed mitigation measures will mitigate concerns about chlorinated compounds, dioxin, furans, BOD, COD, color, AOX and whole effluent toxicity. It bears repeated emphasis that in every case, these mitigation measures will reduce any effects to listed species in absolute terms, not just compared to permit levels analyzed in the BE.

Very truly yours,

Susan Somers
Environmental Manager

Appendix 4.

Amendments to the Biological Evaluation

of

March 2, 2004

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

March 2, 2004

Reply To
Attn Of: OW-130

David Mabe
NOAA Fisheries
Snake River Habitat Branch Office
10215 W. Emerald, Suite 180
Boise, ID 83704

Susan Martin
U.S. Fish and Wildlife Service
Ecological Services Spokane Office
11103 Each Montgomery, Suite 2
Spokane, WA 99206

RE: Amendments to the Biological Evaluation for the Potlatch Mill in Lewiston, Idaho

Dear Mr. Mabe and Ms. Martin:

This letter is to provide you with amendments to the Biological Evaluation prepared by EPA on December 1, 2003. These amendments modify the conservation measures in Section VII.H of the Biological Evaluation for temperature and total suspended solids and add an additional monitoring plan conservation measure to address the uncertainties described in the Biological Evaluation. These new and revised conservation measures are intended to mitigate the effects of the action, but they do not modify the effects determinations described in the Biological Evaluation.

In a letter dated December 19, 2003, the Potlatch Corporation submitted revisions to the mitigation measures they have agreed to do for temperature and total suspended solids. First, the following amendments are made to conservation measure #9 *Potlatch Temperature Reduction Measures*:

Heat Recovery Projects
Change the date in the second sentence to **June 30, 2004**. Add the following after the second sentence, "**Potlatch may implement these projects before reissuance of the NPDES permit**."

Flow Augmentation of Clearwater River Water in the ASB Discharge Pipe
Replace the second sentence in the second paragraph with the following, **"Each year, the system will begin operation May 15 and operation will cease September 30."**

Add the following section:

<u>Operation and Maintenance Activities</u>
Upon reissuance of the permit, Potlatch will implement the following measures during the time period of May 15 through September 30:

- **Manage the foam blanket on the ASB to maximize the pond's ability to shed heat. This will be accomplished by the addition of non-toxic chemical defoamers coupled with the use of sprinklers around the periphery of the ASB.**
- **Implement an aeration control strategy that maximizes the amount of evaporative heat loss from the ASB.**
- **Utilize high-volume Rainbird-style sprinklers located around the periphery of the ASB to reduce the temperature of the ASB by evaporative heat loss and dissipate surface foam, reducing the insulating effect of the foam blanket.**

Second, the amendment made to conservation measure #10 *Potlatch TSS Reduction Measures* is to replace the section titled "Release of TSS 30% below effluent limitation" with the following:

<u>Reduce TSS by 25%</u>
Potlach will reduce TSS by 25% (determined by comparing a 12-month rolling average of the Mill's TSS discharge to 2002 discharge levels). Potlatch will seek to accomplish this goal in the first year of operation under the renewed NPDES permit, but no later than three years from the effective date of the permit.

Finally, the addition of conservation measure #12 *Monitoring and Assessment Plan for Exposure and Effects of Effluents from the Potlatch Pulp and Paper Mill to ESA Listed Salmonids and their Habitats* is added to the Biological Evaluation. This conservation measure also supplements conservation measures #1 through #5 and is provided in the attached document to address the uncertainty of information identified in the Biological Evaluation.

If you have any questions or concerns regarding these amendments, please contact me at (206) 553-6705.

Sincerely,

Kristine Koch
Acting Manager
NPDES Permit Unit

cc: Sue Somers, Potlatch Corporation

Appendix 5.

EPA's Monitoring and Assessment Plan

of

March 1, 2004

Monitoring and Assessment Plan for Exposure and Effects of Effluents from the Potlatch Pulp and Paper Mill to ESA Listed Salmonids and their Habitats

Overview of the Monitoring and Assessment Approach

The goal of this monitoring plan is to further characterize the effects that Potlatch's NPDES discharge permit for its facility near Lewiston, Nez Perce County, Idaho, which discharges into the Snake and Clearwater Rivers, will likely have on endangered and listed species and the environment by conducting studies that address the uncertainties described in EPA's biological assessment. Information gained from this monitoring plan will be helpful in affirming or modifying EPA's effects determination on ESA listed species, their prey and habitat from the Potlatch discharge, and will also be useful in establishing future NPDES permit limitations.

This monitoring plan is not intended to be a detailed work plan that describes all sampling locations, the number of samples to be collected, or a detailed schedule of monitoring tasks. It is the responsibility of Potlatch to prepare a work plan that provides the technical details of implementing the tasks described in this monitoring plan, as well as a schedule for performing the work. This more detailed work plan is required to be submitted to EPA within 180 days after reissuance of the NPDES permit. This monitoring plan does provide a listing of the types of studies EPA believes are necessary to meet the above goal, as well as providing a recommended approach and sequence for performing the various listed monitoring tasks. EPA recognizes that not all tasks discussed in this monitoring plan can be performed concurrently within the first year of the reissued NPDES permit, nor is that our intent. However, EPA expects the Tier 1 tasks to be completed in 2-3 years.

This monitoring plan includes 4 elements that are necessary to achieve the goal of protection of human health and the environment. These are:

1) Characterization of the chemical and physical components of the action area: Potlatch effluent from its discharge point near the confluence of the Snake and Clearwater Rivers to the downstream end of Lower Granite Reservoir,
2) A determination if contaminants from the Potlatch effluent are bioaccumulated by endangered fish species, or fish species consumed by humans,
3) Development or modification of contaminant benchmarks for the protection of salmonids, their prey, habitat, and wildlife, and
4) Characterization of the potential effects to both ESA listed and other biota in the action area.

Each of these 4 elements is related to characterizing the action area, reducing uncertainties in the BO, and determining through *in situ* studies if ESA listed species, their prey and habitat are or will be harmed (Table 2).

Table 1. The rationale for major elements of the plan.

Task	Rationale for Task	Utility of information for regulatory decision making
Characterize chemical and physical components of the action area	Defines spatial and temporal distribution of contaminants. Assists in identifying portions of the action area in which ESA listed species, their prey and habitat are likely to be found. Identifies locations where discharge of effluent may have adversely modified listed species critical habitat.	Defines exposure routes of listed species to contaminants from Potlatch effluent. If exposure routes cannot be identified, it is unlikely that ecological receptors are at risk from contaminants discharged in Potlatch effluent, or conversely whether observed biological effects are due to Potlatch's effluents.
Determine if contaminants from Potlatch effluent are bioaccumulated in invertebrates or fish	Documents bioavailability and exposure to chemical contaminants by prey of listed salmonids (or surrogates for the prey or listed salmonids), or in species consumed by humans.	Permits comparison of resident biota contaminant body burdens to tissue residue benchmarks. Residues exceeding benchmarks, and which are at levels associated with adverse effects provides an indication that bioaccumulated chemicals may be causing harm to ESA listed species or to human consumers of fish.
Develop contaminant benchmarks for protection of salmonids, their prey, habitat and wildlife	Site-specific benchmarks reduces the uncertainty in the use of toxicity benchmarks. If site-specific benchmarks cannot be developed, the benchmarks are derived from the toxicological literature of contaminant impacts on species taxonomically related to ESA listed species. Benchmarks are believed to represent no adverse effect concentrations in environmental media or tissues.	Benchmarks describe chemical concentrations which, if not exceeded in environmental samples and resident biota, provide supporting evidence that discharges are not harming ESA listed species.
Characterize potential effects to biota in the action area	*In situ* measure on resident biota of contaminants associated with Potlatch's effluents. Compare measured effects with predicted effects anticipated in the BE and BO. Effluent impacts on ESA listed species may place those species in jeopardy. Effluent impacts on prey species adversely affects the ability of critical habitat to function as a source of prey during ESA listed species rearing.	Potentially a direct measure of adverse impacts to listed species and their habitat (including prey) from Potlatch effluent, can provide a direct measure of a taking (or incidental take (USFWS and NMFS 1998). Component of an "integrated approach" to water-quality toxics control (along with effluent chemical and whole effluent toxicity (WET) controls (EPA 1991).

The general framework of the sequence and types of monitoring are illustrated in Figure 1 and Table 2. The framework consists of three types of monitoring tasks:

1. Routine effluent and ambient water monitoring
2. Non-routine effluent and ambient water monitoring
3. Special ESA species studies

The specific monitoring tasks within each of the above three types of monitoring tasks are specified in Table 2.

Routine effluent and ambient water monitoring tasks include parameters such as TSS, temperature, nutrients, quarterly WET testing, etc. that are currently monitored on a frequent basis throughout the life of the permit. These monitoring parameters, frequency of analysis, and sampling locations are described in the permit itself, and will not be described in any detail in this monitoring plan. Non-routine monitoring tasks are performed on a less frequent (quarterly) basis than the routine monitoring tasks. Non-routine tasks are the high volume water sampling, which will be described in a later section of this monitoring plan.

Special ESA species studies are the primary emphasis of this monitoring plan. Most of the special ESA studies are intended to be one time studies designed to answer specific questions regarding the impacts of Potlatch effluent on endangered species and their critical habitat. The special ESA species studies are performed in one of two tiers, with the performance of studies placed in Tier 2 of Table 2 contingent upon the results of the studies performed under Tier 1 of Table 2. All studies listed in Tier 1 of Table 2 must be performed.

As the Biological Opinion believes there is a potential of the effluent to both directly and indirectly affect listed species, Tier 1 studies have been selected to evaluate potential effects of the effluent on both ESA listed species (juvenile salmonid studies) and the other major components of the food web leading to salmonids, including water column, sediment, caged mussel and benthic invertebrate tissue analyses. These analyses should permit an evaluation of the contaminants in both the water column and sediment, as well as potential impacts of the effluent on the physical habitat of benthic species that may serve as prey to the listed species.

The process for gathering information and reaching conclusions regarding the likelihood of adverse effects is initiated with the question "what is the likelihood that the chemicals in the Potlatch effluent are harmful to endangered species" and ends with a determination of monitoring tasks to be performed as part of a routine monitoring program (Figure 1). With regards to ESA listed species, their prey and habitat, the purpose of the routine monitoring program is to provide assurance that the contaminants will not cause harm to the species during the life of the permit.

Contaminant benchmarks and loading limits in the permit and this monitoring plan are assumed to be protective of ESA listed species, their prey and habitat. However, there are uncertainties regarding the protectiveness of the permit limits and benchmarks in this monitoring plan, which were derived from literature studies of the toxicity of chemicals in Potlatch effluent. These uncertainties in the permit limits and benchmarks will be evaluated by performing the studies listed in this monitoring plan. If justified based on the findings of this monitoring plan, benchmarks can be revised either upwards or downwards as warranted. Choosing to revise the benchmarks is a decision which could be made at any time during the life of the permit. Thus, it is shown as a separate piece in the flow chart (Figure 1).

The summaries of tasks in Table 2 list sampling and analysis tasks by phases. The "Phase 2" tasks would only be undertaken if indicated by a "Phase 1" tasks. For example, long-term WET tests evaluating reproductive endpoints in fish would only be undertaken if results of field surveys or juvenile or adult salmonids indicated effluent exposure or health effects. Sediment toxicity testing with amphipods or other test organisms would only be done if field surveys of benthic communities showed abundances of amphipods or other benthic organisms were depressed, and Potlatch effluents could not be ruled out as the cause for the field surveys.

Tissue monitoring of resident fish such as smallmouth bass or largescale suckers has a somewhat unique role in this monitoring plan. One use for analyses of resident non-ESA listed species would be to revise the fish tissue benchmarks, which would require a site-specific a food web study using resident fish. A second use of resident non-ESA listed fish tissue analyses is to evaluate wildlife and/or human health risks from consumption of resident fish exposed to Potlatch effluent.

Table 2. Summary of durations and frequency for sampling and analysis tasks.

Phase	Task	Task Duration and Evaluation Notes	Measurement Frequency	
			Temporal	Spatial
Routine Effluent and Ambient Water Monitoring				
1	"Routine NPDES" water chemistry, WET testing	Throughout the life of the permit	As per permit	At the effluent , downstream gradient, and reference stations
Non-routine Effluent and Ambient Water Monitoring				
1	Non-routine NPDES-water column chemistry (e.g. high volume/low detection limit sampling	Throughout the life of the permit, unless results downstream of the outfall indicate ambient concentrations of chemicals are consistently lower than water quality guidelines	Quarterly	Effluent, downstream gradient, and reference stations
Special ESA Listed Species Studies – Tier 1				
1	Sediment deposition area identification	One time study with subsequent field validation	One time, prerequisite for other studies	Reference and gradient stations downstream to LG Dam
1	Sediment chemistry	Until concentrations are below benchmarks at each stations for 95% of the samples or no statistically significant difference between reference and downstream stations	One time	15-20 stations with 4 replicate samples at each station.
1	Benthic invertebrate tissue analyses	Assuming no significant difference between upstream and downstream stations, one time study; otherwise TBD.	One time	6 downstream stations 2 upstream stations
1	Juvenile salmon exposure and health	Assuming no significant difference between hatchery reference and post-LGR transit fish, one time study; otherwise TBD.	One time	LG Dam and hatchery reference
1	Caged bivalve study	Assuming no significant difference between upstream and downstream stations, one time study; otherwise TBD.	One time	6 downstream stations 2 upstream stations
1	Resident non-ESA fish survey	Assuming no significant difference between upstream and downstream stations, one time study; otherwise TBD.	One time	6 downstream stations 2 upstream stations
Special ESA Listed Species Studies – Tier 2				
2	Steelhead exposure and health	Assuming no significant difference between fall and late winter samples, one time study;	October and February	Confluence area
2	Benthic community composition	Assuming no statistical correlation with Potlatch effluents, one-time study	One time	6 downstream stations 2 upstream stations
2	Food web (benchmark) study	Until the measured parameters and bioaccumulation modeling is complete	One time	TBD
2	Modified WET (long-term salmonid or fathead minnow)	May be needed if significant difference between reference and downstream stations for fish tissue benchmarks or health effects	One time	TBD
2	Sediment toxicity testing and toxicity identification	May be needed if benthic community shows adverse effects that cannot be fully explained by environmental variables unrelated to Potlatch effluents (e.g. velocity, upstream sedimentation)	TBD	Likely locations are same as those used for benthic tissue analyses

Characterizing chemical and physical components of the action area

This element of the monitoring and assessment plan will provide data on the distribution of suspended and settleable solids and contaminants over space and time. These data will be used to complete the assessment of the likelihood of adverse effects to endangered species, their prey, and habitat as well as determine the boundaries in space and time for the routine effluent monitoring program. One of the major concerns raised in the Biological Opinion was that the deposition of suspended solids discharged from the outfall will settle in areas with benthic invertebrate resources that serve as prey for ESA listed species, thus physically altering critical habitat and adversely impacting prey sources for the listed species.

The type and location of the physical and chemical components of this phase of the monitoring and assessment plan may include: model and measurements of suspended and settleable solids, predicting locations in the Lower Granite Reservoir where suspended and settleable solids are most likely to be deposited, and sediment surface chemistry (Table 3). All physical and chemical parameters associated with the fate and transport of these constituents will also be characterized for the mill discharge and the receiving water.

Table 3 . Chemical and physical evaluations and measurements of temperature, suspended and settleable solids, and chemical analysis of these particulates

Task	Environmental Gradient	Mixing Zone Proximity	Analytes
Measurements & predictions of the fate and transport of suspended and settleable solids	✓	✓	grain size distribution, CPOCs, RRP, dioxins and furans, organic carbon, and redox state
Effluent chemistry	✓	✓	grain size distribution, CPOCs, RRP, dioxins and furans, organic carbon, and redox state
Bedded sediment chemistry	Lower Granite Reservoir		CPOCs, RRP, dioxins and furans, organic carbon, and redox state

Table abbreviations: CPOCs - chlorinated phenolic organic compounds; RRP – degraded Resin hydrocarbons, Resin acids, and Phytosterols; dioxins and furans (Table 4)
Environmental gradient – Includes sampling upstream reference stations and a progression of samples downstream of the outfalls;
Mixing zone proximity – sampling focused in the near-vicinity of the diffuser

Table 4. Dioxin and furan congeners to be measured in this assessment.	
TCDD congeners	**TCDF Congeners**
2,3,7,8-TCDD 1,2,3,7,8-PeCDD 1,2,3,4,7,8-HxCDD 1,2,3,6,7,8-HxCDD 1,2,3,7,8,9-HxCDD 1,2,3,4,6,7,8-HpCDD OCDD	**2,3,7,8-TCDF** 1,2,3,7,8-PeCDF 2,3,4,7,8-PeCDF 1,2,3,4,7,8-HxCDF 1,2,3,6,7,8-HxCDF 1,2,3,7,8,9-HxCDF 2,3,4,6,7,8-HxCDF 1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF OCDF

Measurements & predictions of the physical nature of effluent

The determination of sediment transport should include a description of the hydrological and hydraulic conditions that will affect dispersion of the constituents associated with the effluent.

The concentration of TSS in final effluent is measured daily as a requirement of the permit under which Potlatch continues to operate. The proposed monitoring plan includes further analysis of effluent TSS, including measurement of particle size distribution, density, and organic carbon content. These data will be used to gain a better understanding of the composition of TSS. The goal of characterizing effluent suspended solid material is to confirm that the material is, in fact, highly organic.

Effluent and Water Column Chemistry, High Volume Water Sampling

The proposed final permit requires effluent monitoring at Outfall 001 for the limited parameters and for other parameters of concern including flow, production, phosphorus, ammonia, nitrite plus nitrate nitrogen, chemical oxygen demand, and whole effluent toxicity. The effluent monitoring requires analysis of the total concentration of chemical constituent as well as the dissolved fraction. This allows the analysis of the effects from this discharge for both the water column and the particulate matter. The purpose of effluent monitoring is to measure the quality of the effluent being discharged into the receiving water and to ensure compliance with the permitted effluent limitations.

The concentration of TSS in final effluent is measured daily as a requirement of the permit under which Potlatch continues to operate. The proposed monitoring plan includes further analysis of effluent TSS, including measurement of particle size distribution, density, and organic carbon content (Table 5). These data will be used to gain a better understanding of the composition of TSS.

Both solid and aqueous phases of effluent will therefore be analyzed once per quarter for one year, using for dioxins and furans and other chlorinated organic compounds (Table 5).

The concentration of contaminants found in the effluent and the receiving water monitoring will be compared to the permit limits and/or benchmarks proposed in the BE (Table 6). This is a routine monitoring component of the Monitoring and Assessment Plan. The receiving water monitoring activities must be conducted within the same 24-hour period.

Table 5. Sampling Methods, Frequency and Duration

Effluent Characteristic	Sampling Method	Sampling Frequency and Duration
Concentration of TSS in Effluent		Measured daily as required by permit
Particle Size Distribution of TSS	To be determined	Quarterly for One Year
Density of TSS	To be determined	Quarterly for One Year
Organic Carbon Content of TSS	To be determined	Quarterly for One Year
Concentration of CPOCs in Effluent Aqueous Phase	Modified EPA Method 1653	Quarterly for One Year
Concentration of CPOCs in Effluent Solid Phase	Modified EPA Method 1653	Quarterly for One Year
Concentration of Dioxin/Furan in Effluent Aqueous Phase	Modified EPA Method 1613	Quarterly for One Year
Concentration of Dioxins/Furans in Effluent Solid Phase	EPA Method 1613 High-volume aqueous sampling	Quarterly for One Year

Spatially, the high-volume, low detection limit water column sampling of CPOCs and dioxins and furans in the water column will include at least four conditions: effluent, upstream reference area, partially mixed effluent and receiving waters, and fully mixed effluent and receiving waters. Upstream samples should include a station located far enough upstream to be out of any potential atmospheric deposition from the mill's stacks, e.g. near the end of reasonable road access from Lewiston (such as near Anatone, WA, see figure 2.). The "partially mixed" effluent condition should represent conditions after near-field mixing has occurred, such as from the Snake River near the state line about 50m downstream of the diffuser, but upstream of potable water intakes. The (nearly) "fully mixed" condition would represent conditions after nearly all buoyant and turbulent mixing of the effluent and Snake River had occurred, and thus would be representative of concentrations encountered by aquatic life in the majority of the reservoir. This condition would be represented by two or more stations. One would be located fairly close to the diffuser in the far-field mixing zone (~1 km downstream) and the second near the location where CORMIX simulations predicted that fish benchmarks would be met.

EPA will not specify the high volume water sampling procedure to be employed. One possible sampling gear is the Infiltrex sampler manufactured by AXYS Environmental. This unit pumps a large volume of water through a filter, then through a resin column. The filters and resin column are then sent to an analytical laboratory for analysis of suspended and dissolved, respectively, organic compounds. This procedure permits the detection of low concentrations of chemicals in water, without the need to ship large water volumes to an analytical laboratory. Based on preliminary discussions with AXYS staff and EPA Region 4 staff familiar with the sampler, a 400 L sample should be sufficient to permit detection of all chemicals in Table 6 at the benchmark concentrations.

EPA recognizes that the high volume water sampling task requires the expenditure of considerable resources. To reduce the potential expenditure of time and labor on this task, EPA will remove the requirement for high volume water sampling in ambient waters (both upstream and downstream of the outfall) if the results of the first four quarterly monitoring periods demonstrate that all chemicals with benchmarks in Table 6 are only present at concentrations lower than their respective benchmarks during all four sampling periods.

Two chemicals (phytosterols and retene) do not have identified tissue benchmarks in Table 6. In the case of phytosterols, this is because the log K_{OW} for ß-sitosterol, the phytosterol used as a surrogate compound for all phytosterols during benchmark derivation, is 9.3. This high a log K_{OW} tends to drastically overestimate bioaccumulation potential in regressions of log BCF and log K_{OW}. Also, we have been unable to identify any studies in the primary aquatic toxicology literature that associate measured phytosterol residues in aquatic biota tissues with adverse effects. Without any empirical data associating phytosterol residues with toxicity, EPA currently believes that the uncertainties associated with any tissue benchmark we could derive for phytosterols would limit the utility of such a benchmark in a regulatory context. In the case of retene, which is a PAH compound, the potential for rapid transformation of the parent compound by aquatic biota and/or the potential for photoactivated toxicity precludes the derivation of a retene tissue benchmark with any utility in a regulatory context.

Table 6. Benchmarks or effluent limits for toxic chemicals

	Benchmarks								
	Water column benchmarks		Lowest Water Quality Std	Fish tissue	Sediment	Permit limits		Effluent baseline	**Effluent/ benchmark
	salmonids	prey				max	mean	ug/l	
	µg/l*	µg/l*	µg/l*	µg /kg*	µg /kg-oc*	µg/l*	µg/l*		
Chloroform	12.40	27.00	5.70			81.0	48.0	710.00	
2,4,5 trichlorophenol	2.60	3.40	1 T&S	724	11281	2.5		0.91	0.35
2.4.6 trichlorophenol	7.30	32.00	2 T & S 2.1HH	1994	30965	2.5		0.91	0.12
2,3,4,6 tetrachlorophenol	3.30	10.00		3990	78189	5.0		1.80	0.55
pentachlorophenol	0.18	0.02	0.28HH	808	19432	5.0		1.80	10.00
3,4,5 trichlorocatechol	2.60	34.00		724	11281	5.0		1.80	0.69
3,4,6 tetrachlorocatechol	2.60	34.00		724	11281				
tetrachlorocatechol	11.00	127.00		8154	148004	5.0		1.80	0.16
3,4,5 trichloroguaiacol	7.50	45.00		4572	80471	5.0		1.80	0.24
3,4,6 trichloroguaiacol	2.60	3.40		1071	17740	2.5		0.91	0.35
4,5,6 trichloroguaiacol	2.60	5.00		783	12350	2.5		0.91	0.35
tetrachloroguaiacol	10.00	10.00		18218	332721	5.0		1.80	0.18
trichlorosyringol	2.60	85.00		1927	34983	2.5		0.91	0.35
phytosterols	2.5			NGR					
resin acids	2.2								
retenes	3.2			NGR					
	pg/l		pg/l	ng/kg	ng/kg-oc	pg/l	pg/l	pg/l	
2,3,7,8 TCDD	0.06		0.013 human health	9 (TEQ)	381.00	3.76	2.58	3.65	57.94
2,3,7,8 TCDF	0.20				955.00			11.60	58.00
AOX (TU)	Tu=1								129.28

*units in µg/l, µg/kg, µg/kg-oc, except for 2,3,7,8 TCDD, 2,3,7,8 TCDF
oc = organic carbon
T& S = Taste and Smell
NGR = No Guideline Recommended
HH = Human health
TU = sum of the effluent/benchmark ratios for each of the organic chemicals
TEQ = Toxicity Equivalency Factors for Dixoins and Furans (Table 7)
Fish tissue benchmarks are whole body wet weight, unless specified otherwise

Table 7. Toxicity Equivalence Factors (TEF) for dioxins, and furans (Van den Berg et al. 1998)			
Dioxins		**Furans**	
Congener	**TEF**	**Congener**	**TEF**
		2,3,7,8-TCDF	**0.05**
2,3,7,8-TCDD	**1**	1,2,3,7,8-PeCDF	0.05
1,2,3,7,8-PeCDD	1	2,3,4,7,8-PeCDF	0.5
1,2,3,4,7,8-HxCDD	0.5	1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDD	0.01	1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDD	0.01	1,2,3,7,8,9-HxCDF	0.1
1,2,3,4,6,7,8-HpCDD	0.001	2,3,4,6,7,8-HxCDF	0.1
OCDD	<0.0001	1,2,3,4,6,7,8-HpCDF	0.01
		1,2,3,4,7,8,9-HpCDF	0.01
		OCDF	<0.0001

Bedded Sediment Analysis

Any sampling plan is contingent on the goals for the project, the pattern or contamination, data variability, and the available information. There are several strategies for search sampling a system such as the Lower Granite Reservoir to find depositional areas. These strategies include haphazard, judgment, and statistically based search sampling. Statistically based methods include probability sampling, which includes stratified random, systematic, and cluster sampling (Gilbert 1987). Gilbert (1987) has more advice for designing appropriate sampling strategies

In this case, little information exists regarding the location of sediments, variability, and spatial pattern of deposition in a 40 mile long reservoir (= action area). Because relatively little information about sediment deposition areas in the Lower Granite Reservoir exists, the downstream extent of measurable deposition of contaminants from Potlatch effluent is unknown. The organic contaminants discharged from Potlatch are most likely to bind with high organic carbon content sediment, which is often associated with fine grained sediments. Identification of high organic carbon content, fine grained sediment between the outfall and Lower Granite Dam is a prerequisite for selecting sampling locations for several other tasks in this monitoring plan, including sediment chemistry, benthic invertebrate tissue sampling, and benthic community composition studies.

EPA will not specify the method by which Potlatch will identify sediment depositional areas. Acceptable methodologies include mathematical modeling, a side-scan sonar survey, or search sampling. The final methodology selected by Potlatch will be reviewed by EPA for acceptability prior to the start of this task. Search sampling, which can also be used to locate contamination hot spots, will likely involve collection of a large number of samples.

The goal of this task is to determine the sediment depositional areas downstream of the outfall and in Lower Granite Reservoir. If it can be demonstrated that some areas are never depositional, then strata may be generated and we will go to a stratified random sampling scheme and sample those strata that are depositional. Because it is unknown which areas of the Lower Granite Reservoir will contain the highest concentrations of contaminants, a large sampling effort will be required initially to determine where the TSS from the mill and riverine sediment that has sorbed contaminants are deposited. It is assumed that aqueous concentrations of contaminants from the mill's effluent will associate with bedded sediment and particulates in the water column. Because of the limited amount of information regarding where contaminants will likely settle in the Lower Granite Reservoir, a comprehensive effort to identify sediment deposition areas will be required.

<u>Two possible options are presented below for search sampling and analysis.</u>

<u>Cycle 1 – Stratified random sampling of depositional areas with accumulations of fine grained sediments (Option 1, stratification based on previous studies)</u>

An important prerequisite to assessing potential sediment contamination from Potlatch's effluents and subsequent exposure of aquatic organisms, is to determine where particulates in the effluent likely settle out. Two general options for selecting these locations are to use existing surveys of sedimentation in the reservoir to identify candidate sites ("option 1") or if the existing information is inadequate or for other reasons "option 1" is not completed, then a stratified random sampling approach ("option 2") would need to be completed.

In the first option, existing surveys of the river/reservoir system would be used to locate areas where depositional areas with fine grained substrates occur. These areas would likely need to be evaluated by reconnaissance to see if they are relatively little disturbed by vessel traffic or water level fluctuations, which might confound data interpretation. Such reconnaissance might include taking numerous Ponar grab or core samples of candidate locations, inspecting the samples for visual oxic/anoxic layers, substrate sizes, and probably other field observations.

A time-series of 6-years of sediment chemistry data has been collected at 4 – 7 stations in the Snake and Clearwater rivers above and below Potlatch's outfall. To the extent that these sampling stations correspond with the locations vetted through the above process, retaining these stations will give a temporal aspect to the monitoring results. However, the process for selecting these locations was apparently informal and is not yet well understood. For example, Potlatch representatives have stated that the selected sediment sampling locations were purposefully selected to be representative of the few locations where sediment accumulates in the river (Ginsberg 2004). However, so far no details of surveys or other written accounts of how candidate sampling sites were selected have been reviewed. Similarly, a report summarizing dioxin and furan concentrations in sediments at 4 – 7 stations in the Snake and Clearwater rivers above and below Potlatch's discharge gives no details of what types of riverine or reservoir conditions the stations are expected to be representative or the rationale how these stations were selected (AMEC 2003). The representativeness of at least one of the stations (Red Wolf Marina, RM 137) was questioned by a Potlatch representative due to prop wash disturbances and resorting of the sediments (Allison Gargani, personal communication).

Investigations on behalf of U.S. Army Corps of Engineers (ACOE) provide a wealth of information for targeting candidate sediment sampling locations (Cunningham 1993; PNNL 2002). PNNL (2002) surveyed about 50 cross sections of the Lower Granite Reservoir and nearby reaches of the Snake and Clearwater rivers. Significant (>≈ 3 feet) sediment depositions were found at about RMs 137, 131, 123-126, 114-121, and 108 (PNNL 2003, figures 7.2 and 9.3). Largest amounts were found at around Kelly Bar to Bishop Bar at about RM 119 and near about RM 125. During the 1992 reservoir drawdown tests, massive erosion was observed from the lower Snake and Clearwater riverine reaches and their confluence area, but most of the material was deposited with 1 –2 miles downstream (Cunningham 1993, plate 16). Subsequent sediment mobilization simulations found that in the impounded river, even for the 90th percentile flows (111,500 cfs) only very fine gravel or sand were predicted to be transported through Lower Granite pool, and at median (31,710 cfs) and low (20th percentile) flows (19,900 cfs) only fine sand-sized (0.125 mm) were predicted to be transported the length of the reservoir. The simulations suggest the impounded river loses its competence to move even fine particles under median flows at about the locations where large deposits of sands and fines were found (PNNL 2002). At a sampling site at about RM 120, deposition of about 2 inches of fines that are high in organic matter occurred annually (Bennett et al. 1993, p. 184).

Based on this cursory review of fluvial geomorphology and hydraulics studies, it seems likely that a thorough review could provide much insight on initial targeting of sediment sampling program review. A "thorough review" would probably include several days in the PNNL and ACOE offices carefully reviewing the actual PNNL survey cross section field records (rather than relying on the small, report, figures), inspections of the ACOE aerial photos of Lower Granite Reservoir taken during the 1992 drawdown or subsequent flights of low-pool conditions, discussions with investigators from those studies, and so on. Generally, the approach would take the following:

1. Break out the study area into strata (described in Option 2),
2. Overlay existing sediment transport, deposition, and substrate survey results (described above) over the strata,
3. Eliminate strata that are not expected to have accumulations of fine-grained sediments.
4. Select a randomized sample of remaining strata to be sampling (i.e. stratified random sampling scheme).

It would be prudent to do this selection in consultation with a professional statistician to optimize the design, including optimizing statistical power. Additionally, the results of the sample selection process should be reviewed to see if they are sensible, such as whether shallow embayments such as around Silcott Island are included.

<u>Cycle 1 – Stratified random sampling (Option 2, without stratification based on previous studies)</u>

This second option is fundamentally the same as the first, except if the tabletop comparison of strata with sediment deposition areas wasn't done, it would be done through field sampling. For the first year (cycle), each mile of the reservoir downstream of the outfall diffuser (32 miles) will be divided into sections. These sections will each be divided into a small number of strata (e.g., north river bank, south river bank, channel, any embayment). For the entire Lower Granite Reservoir, this sampling scheme will consist of approximately 96 - 128 strata (3 - 4 strata within each mile).

Within each stratum, 2 - 3 sediment samples will be taken at random and analyzed separately. To reduce the sampling effort, a detailed map of the depositional areas in the Lower Granite Reservoir will have to be generated, similar to what was done for the McNary reservoir in ACOE (2002). If it can be demonstrated that some of these strata contain a low percentage (e.g., <1%) of particles finer than 63 microns (sand) for all months of the year, then sampling will not be required. Also, If it can be demonstrated that the contaminant concentrations are homogeneous in most areas or that fine sediment does not occur in many locations in the Lower Granite Reservoir, then strata may likely be combined in an effort to focus on hot spot location in succeeding cycles.

Additional cycles

Once cycle one is completed and the data indicate homogeneity of sediment concentrations or large areas without bedded sediment, then larger strata may be considered. . For the second year (cycle) the Lower Granite Reservoir could be divided into 30 or 40 large strata. This will entail 8 or 10 sections downriver with the same transectional strata (e.g., north and south river bank, channel, embayments). Three or four samples will be taken at random within each stratum for a total of 100 - 160 samples.

If there is evidence that sediment or TSS settle disproportionately near the diffuser or at the dam, this option may be modified to skew the downstream samples. With this information, sections of the river will increase in size with downstream distance. For example, strata could be bounded by the distances of 10m, 100m, 500m, 1,000m, 5,000m downstream of the diffuser. The other sections will be at the dam, 50m, 100m, and 500m upstream of the dam. Each section will still be divided into 3 or 4 strata (as above) for a total of 24 to 32 strata plus the one upstream stratum. These strata will be disproportionate in size with smaller strata near the diffuser and Lower Granite Dam. The same number of random samples will be taken within each stratum.

Random samples will be collected upstream of the diffuser in the Snake and Clearwater Rivers and outside the influence of the incinerator at the mill. One stratum will be located next to the treatment pond and include the entire area known to leach into the Clearwater River. This stratum will require several samples to determine the extent of contamination in the bedded sediments.

Bedded sediment chemistry

All chemicals of concern will be measured in sediments including dioxins and furans, most chlorinated phenolics, retene, lignin, phytosterols, and resin acids (Tables 4, 5). Additionally, standard sediment parameters such as grain size distribution, organic carbon content, and redox state will be determined for each sample. The depth of sediment sampling will be determined at a later date, but should be sufficiently deep to include the biologically active zone.

Frequency and duration of sampling and analysis for bedded sediments

The physical and chemical characterization of the particulate matter includes basic elements (fate and transport, depositional zones, bioaccumulation parameters, etc) that should be completed within the first year(s) of the permit. After the fate and transport of particulates and associated chemicals has been clearly described, a set of 15 – 20 discrete locations will be chosen for routine monitoring during the life of the permit. The actual number of sampling locations will be dependent in part on the number and location of sediment depositional areas previously identified as part of this monitoring plan. Sampling locations will include reference area stations upstream of the outfall in both the Snake and Clearwater Rivers. The data from these locations will be compared to benchmarks for sediment and water to assure that leaching of contaminants does not occur. In cases where there are no sediment benchmarks, sediment to water partition coefficients will be used to estimate water concentrations.

Based on historical sediment data collected by Potlatch and the Army Corps of Engineers (ACOE 1999, Appendix B), we have attempted to identify the analytical variability that can be expected during monitoring of sediment chemical concentrations. The organic chemical most often detected in previous monitoring studies of Lower Granite Reservoir is the chlorinated insecticide 4,4'-DDE. Although not a chemical of concern in Potlatch effluent, we have assumed that the variation in DDE sediment concentrations in Lower Granite Reservoir samples is representative of that which could be found for the chemicals discharged in Potlatch effluent.

According to ACOE (1999) the mean concentration of 4,4'-DDE in Lower Granite Reservoir is 4.89 ng/g, with a standard deviation of 5.05 ng/L. Starting with this amount of variation, and designing a monitoring plan able to detect statistically significant chemical concentrations at a statistical significance (α) of 0.05 and a statistical power ($1 - \beta$) of 0.80, we have used statistical power analysis software (http://www.health.ucalgary.ca/~rollin/stats/ssize/index.html) developed by Rollin Brant at the University of Calgary to estimate the number of replicate samples per sampling location required to identify stations whose sediment chemical concentrations differ by a factor of 3 times. This analysis indicates that four replicate samples per sampling station is sufficient to detect a 3x concentration difference between two stations with an $\alpha = 0.05$ and a power of 0.80. Statistical power is defined as the probability of accepting an alternative hypothesis (in this example, chemical concentrations at a downstream sampling station is significantly higher than the concentration at an upstream reference station) when the alternative is actually true.

The sample size and statistical power discussion in this section is only meant to serve as an example of using a statistically based approach to the design of the monitoring in the work plan to be developed by Potlatch. The assumptions used in our sample size determination example presented here may or may not be the most appropriate for use during work plan development. EPA strongly recommends that Potlatch retain the services of a qualified statistician during the development of the work plan.

The list of chemical analytes required to be monitored during the sediment sampling (Table 6) includes at least one chemical (3,4,5-trichloroguaiacol) known to be specific to pulp and paper mill effluent (Marmorek et al. 1992), as well as a number of other compounds commonly found in pulp and paper mill effluent. To the extent that 3,4,5-trichloroguaiacol is found downstream of the Potlatch outfall, it may serve as one indicator of the downstream extent to which chemicals in the effluent have a potential to adversely affect biological resources. It is not the only indicator of effect, however, as other compounds may be transported downstream further than is 3,4,5-trichloroguaiacol, depending on their environmental fate, transport and persistence in the environment.

If it is assumed that tissue chemistry analyses are also as variable as DDE in sediment and it is desired to detect a 3x difference in concentrations between stations, 4 replicate tissue samples per sampling location would also be required. For the purposes of this monitoring plan, EPA assumes that four replicate samples per sampling location will be needed to detect a 3x change in chemical concentrations between sampling stations.

Characterize potential effects of contaminants on biota

There are seven biological components in this monitoring and assessment plan (Table 8) which will be used to determine the likelihood that adverse effects are occurring to endangered species as a result of exposure to contaminants in the Potlatch effluent. The order in which the studies in Table 8 will be performed (i.e. staged or tiered) in this monitoring plan is presented in Table 2.

Table 8. Biological monitoring and assessment components

Task	Environmental Gradient	Mixing Zone Proximity	Analytes
Invertebrates:			
1. Forage Invertebrate tissue residues	✓	✓	CPOCs, TCDD/TCDF
2. Benthic macroinvertebrate community analysis	✓		Taxa enumeration and identification; community metrics
3. Caged bivalve study	✓	✓	CPOCs, RRP, TCDD/TCDF, growth & survival, hormonal changes
Fish:			
4. Resident Fish tissue chemistry & health effects	✓	✓	CPOCs, RRP, TCDD/TCDF, fish health
Anadromous fish tissue & health:			

Table 8. Biological monitoring and assessment components			
Task	**Environmental Gradient**	**Mixing Zone Proximity**	**Analytes**
5. Juvenile salmon	✓		CPOCs, RRP, TCDD/TCDF, fish health
6. Adult steelhead pre-exposure tissue & health (Oct-Nov) and (Feb-Mar)		✓	CPOCs, RRP, TCDD/TCDF, fish health
7. Whole effluent Toxicity	As per permit	✓	Toxicity

Table abbreviations: CPOCs - chlorinated phenolic organic compounds; RRP – degraded Resin hydrocarbons, Resin acids, and Phytosterols; TCDD/TCDF – dioxins and furans

Environmental gradient – Includes sampling upstream reference stations and a progression of samples downstream of the outfalls;

Mixing zone proximity – sampling focused in the near-vicinity of the diffuser

Tier 1 ESA Listed Species Biological Studies

<u>Invertebrates</u>

<u>Benthic invertebrate tissue residues.</u>

Benthic invertebrates are the primary food source for juvenile salmonids and can be an important pathway for exposure of fish to contaminated sediments. Benthic invertebrates may be exposed to contaminated sediments by directly ingesting sediments or detritus or exposure through the gills from pore water.

Benthic macroinvertebrates will be collected from subset of depositional areas that will also be sampled for sediment chemistry which include, a) background Snake River, b) gradient from diffuser to near Lower Granite dam. These sampling stations should generally correspond with stations used for caged bivalve study, however practical considerations may make some separation necessary.

Suggest targeting similar taxa (or at least members of the same functional feeding groups) to lessen confounding differences. Previous work has reported that the benthic invertebrate community in Lower Granite Reservoir is low in diversity and dominated by oligochaetes and chironomids (Muir and Coley 1996). Suggest targeting chironomids because 1) they are abundant so collecting adequate sample for analysis should be feasible even though the individuals are tiny; and 2) the chironomids are important in the diets of juvenile salmon (Muir and Coley 1996; Rondorf et al. 1990).

Caged bivalve study

Biomonitoring studies of field collected benthic invertebrates or fish for bioaccumulation and effects have high environmental realism, but are sometimes confounded by species differences, mobility and associated unknown exposure history of the sampled species. Studies with caged organisms may give a direct means to map and monitor effluent effects in a controlled, but still environmentally realistic manner. Exposures longer than a ≈1-2 weeks with caged fish may be difficult of prey limitations and feeding artifact effects. In contrast, a bivalve field assay can be a good surrogate for estimating potential effects in fish and other organisms due to bioaccumulations (ASTM 2001; Environment Canada 2002). A limitation to the use of caged bivalves as a surrogate of invertebrate prey for salmonids is their different feeding strategy than most salmonid-prey invertebrates have. Bivalves may reflect exposure to contaminants that are dissolved in the water column and since they are filter feeders, may also reflect exposure to contaminated sediments sorbed to suspended particulates. Most benthic invertebrate prey of salmonids are in different feeding guilds than bivalves (e.g. grazers or detritivores). Thus the two lines of evidence provided by the two approaches to evaluating contaminants in invertebrates may be complementary, where the strengths of one offset the limitations of the other.

Results of the bivalve field bioassay can be used to predict bioaccumulation and biological effects likely to occur in other aquatic organisms under comparable field conditions. Equilibrium partitioning theory, quantitative structure activity relationships, and critical body residue theory suggest that tissue burdens of chemicals associated with adverse effects may be similar across species The ecological importance of bivalves, their wide geographic distribution, ease of handling in the laboratory and the field, and their ability to filter and ingest large volumes of water and sediment particles make them appropriate species for conducting field bioassays to assess bioaccumulation potential and associated biological effects. Studies comparing the mortality end point in bivalves and other test species have found bivalves to be equally or more sensitive than the other species. When the bivalve growth end point was compared to the mortality end point in other test species, the bivalve growth endpoint was more sensitive (ASTM 2001).

Caged bivalve studies have been successfully used to evaluate bioavailability and effects of pulp mill effluents, contaminated sediments, and complex urban waste streams (Salazar et al. 1995; Salazar and Salazar 1997; in press).

Target Species

A preliminary step to conduct a caged bivalve study of potential effect of Potlatch effluents in the Snake River will be to select a target species and potential transplant source. A cursory review suggests that the Asiatic clam *Corbicula* spp. is common in the Hells Canyon reach of the Snake River and might be a candidate test species. *Corbicula* spp. has been used successfully in caged bivalve studies (Michael. Salazar, personal communication). In 1998 it dominated invertebrate communities for an 8-mile study reach downstream of the Hells Canyon Dam, and were less dominant but still also common in lower Snake River locations (Meyers and Foster

2003). According to a taxonomist with local knowledge, *Corbicula* also occurs in the Snake River near Lewiston. The native mussel *Margaritifera falcata* also occurs in the Snake River, typically in in unconsolidated gravelly or coarse sand substrates (Gary Lester, EcoAnalysts, Moscow, ID, personal communication). Cushing (1993) reported that *Corbicula* clams were found almost everywhere in the Lower Granite areas they surveyed, in the riprap and on exposed sandy beaches, and that some native mussels were found in Lower Granite as well, but were less common (*Anodonta nutalliana* and *A. californiensis*).

A bibliography of Idaho freshwater molluscs listed several reports of mollusc surveys from the Snake River. All included Terrence J. Frest as an author and most were reports to government agencies or hydropower companies (Frest et al. 2001). A report that may be relevant but has not yet been viewed is also included in the bibliography (Frest and Johannes 1992).

Spatial design

Bivalve cages will be deployed in protected areas at about six locations in Lower Granite Reservoir downstream of Potlatch's diffuser. The cages will be located in a progression where the first is on the order of 10s of meters downstream, the second 100s of meters downstream, the third 1 ~ 2 km, and so on so that they are further apart further downstream from the diffuser. For example, 4 stations will be located between the diffuser located near river mile (RM) 139 and Silcott Island near RM 130, and two station between RM 130 and Lower Granite Dam at about RM 110. Each cage will be hung from a support so that the lowest cage is about 1m off the bottom (this may require a submerged buoy or some other creative deployment at the site nearest the diffuser).

Two reference sites are desirable. One located near Hells Gate State Park near the head of Lower Granite Reservoir at about RM 145, and the second will be located well upstream to minimize exposure to hypothesized air deposition of contaminants from the mill or other urban sources. A suitable quiescent site will have to be found that will be suitable for deployment, but as a start, something near the USGS gage at Anatone, WA is suggested (~RM 167) since there is a large pool above a rapids located there, and it is near the end of direct road access from the Lewiston area. The approximate layout of these candidate sites is illustrated in Figure 2.

Environmental variables

Environmental variables that could affect bivalve growth or survival should be monitored so that their potential influence can be interpreted along with potential effects of effluents. These include "continuous" temperature monitoring throughout the deployment with datalogging thermisters, and frequent DO and pH. At least some of the DO and pH measurements should be diel, although sensor fouling makes continuous monitoring over the course of the study difficult. Other recommended environmental and test variables are discussed in ASTM (2001).

Fish

Juvenile Salmon

Direct evaluation of potential bioaccumulation of contaminants and associated measures of exposure and fish health is feasible by analyzing outmigrating juvenile salmon. Research from estuaries has shown that despite their relatively brief residence time there, juvenile salmon in contaminated estuaries encounter increased chemical exposures compared to reference sites. These contaminant effects have been linked to increased susceptibility to naturally occurring pathogens. This in turn has been hypothesized to shift the balance between salmon survival and mortality due to disease (Arkoosh et al. 1998a; Arkoosh et al. 1998b; Stein et al. 1995). Sub-yearling Chinook salmon probably spend about 3-4 weeks in Lower Granite Reservoir (Muir and Coley 1996). During part of that time they could be exposed to directly to Potlatch effluent or indirectly to sediments and invertebrates that were influenced by the discharges.

Sub-yearling fall chinook salmon will be collected and analyzed for chemical contaminants, exposure, and health indicators from fish that had traveled Lower Granite Reservoir and reference hatchery fish. The reference source of fish should be from a hatchery stock that is released into the Snake or Clearwater Rivers upstream of Potlatch's diffuser (e.g. Dworshak or Lyons Ferry).

The testing will need to be conducted around May when the fish are traveling through the reservoir, and should be conducted over at least two seasons. Because of the small size of the fish, fairly large numbers (>≈30) may needed to provide enough liver or other tissues for analyses. Five composites from each site would allow statistical comparisons, although power may be low.

Resident fish tissue monitoring of exposure and effects

Resident fish may be less mobile than anadromous fish and may be more affected by localized pollution sources than fish that spent large parts of their life histories elsewhere. Small-bodied fish (e.g. <≈ 150mm TL) are often less mobile than large bodied fish and may be more affected by localized pollution sources than larger, more mobile fish (Galloway et al. 2003; Munkittrick et al. 2001). For example, suckers, mountain whitefish, and other large salmonids can be highly migratory, so contaminants in their tissues could be from wide sources. Further, their wide-ranges may dilute their exposure to point sources of contaminants. Juvenile salmonids are assumed to be intermediate in their exposure histories. They presumably are exposed to contaminants in reservoirs like Lower Granite for longer times than some adult salmonids, but less than sessile invertebrates and perhaps less than small cyprinids such as chiselmouth.

Recommended target species are smallmouth bass *Micropterus dolomieui* (primary) and largescale sucker *Catostomus macrocheilus* (secondary) based on their expected abundance and feeding/mobility. Smallmouth bass are recommended because they are piscivorous ("trophic level 4" in EPA terminology) and some mark-recapture or telemetry studies suggest reasonable fidelity to a home range. There is some evidence of large seasonal migrations by smallmouth bass from smaller to larger rivers as fall temperatures cooled, and then back in the spring. However, in a reservoir such as Lower Granite, this pattern may or may not occur. Because smallmouth bass could usually be caught, but were sometimes relatively scarce (compared to largescale suckers), a significant fishing effort may be needed to get enough sample. Largescale sucker are recommended as a secondary species. They were consistently abundant in different seasons at a site a few miles below Potlatch's outfall in Lower Granite Reservoir (Tables 7 and 6). Large seasonal movements of riverine largescale suckers and other sucker species have been reported which can confound monitoring. In particular, largescale suckers from a tributary to Lower Granite Reservoir (Wenaha River, OR) were tracked moving in the autumn >100 km downstream to the Snake River and Lower Granite where they spent the winter before moving back upstream in the spring (Baxter 2002). It is possible that fish caught in summer in Lower Granite Reservoir might be "local" fish rather than "visiting" fish and would reflect longer term exposure. Largescale suckers are benthic omnivores and may be exposed to contaminants through their feeding on benthic invertebrates or algae and detritus ("trophic level 3" in EPA terminology). For these reasons, largescale suckers seem useful to include but as a secondary species. Other species could be targeted, although the information reviewed indicated they could be scarce of absent from littoral areas of the reservoir at some times of the year (Tables 7 and 8).

These tissue concentrations would be used to determine potential adverse effects by comparing to tissue-based benchmarks for those compounds that have such values. This will include a dioxin/furan benchmark, which has already been established and possibly a tissue benchmark for chlorinated phenolic compounds. This tissue residue data may then be used in a food web model developed by the EPA to determine the potential for bioaccumulation to listed salmonids in the Lower Granite Reservoir.

In addition to the fish tissue analyses, several biological responses would be measured in resident fish including P450 induction, vitellogenin induction and other reproductive abnormalities, growth, gonadal-somatic and hepato-somatic indices, and others as deemed appropriate for assessing impacts to pulp mill effluents (Table 11).

This could become routine monitoring if an appropriate species could be identified. The species would have to be a resident species that obtained most of its exposure from the Potlatch effluent (or downstream in the Lower Granite Reservoir). Radio-tagging could be used to determine the habitat area for selected fish species.

The results of the fish tissue analysis should be completed during the first year or two of the permit. Depending on the results of the assessment, the analyses may be discontinued. The data from this analysis will be used in the bioaccumulation phase of the permit monitoring program.

Tier 2 ESA Listed Species Biological Studies

Invertebrates

Benthic macroinvertebrate community composition.

Effluents from pulp and paper mills can cause shifts in taxonomic composition due to toxic effects, enrichment, or physical habitat changes (Culp et al. 2000; Kilgour et al. 2004; Lowell et al. 2000; Sibley et al. 2000). Surveys of benthic invertebrates in Lower Granite and lower reservoirs have found low diversity in its fine-grained sediments in comparison to reservoir downstream of Lower Granite dam (Muir and Coley 1996). Amphipods have been abundant in collections from Little Goose, but rare or absent in Lower Granite Reservoir. Following the 1992 reservoir draw down, amphipods were abundant in Little Goose but completely absent at RM 131 at the shallow water site and very rare at the deep water site. Oligochaetes and chironomids made up ~99% of sample. Amphipods were found in qualitative samples from near Lower Granite dam at about RM 108 (Cushing 1993). Similarly, prior to the draw down, oligochaetes and chironomids made up close to 100% of the collections at several sites in Lower Granite Reservoir (Bennett et al. 1993). Because these surveys were not designed to evaluate benthos in reference sites and sites influenced by Potlatch's discharges, it is not known whether the effluents contribute to the very low diversity and absence of amphipods, or whether these conditions are due to unrelated factors such as the hydrology or morphology of the river-reservoir environment. However, amphipods are commonly used in sediment toxicity tests, and are fairly sensitive to many contaminants. Thus, without a better understanding of amphipod and other benthic community distribution in relation to environmental correlates in the Potlatch study area, the possibility that contaminants in the effluents contribute to these patterns should not be ignored. Amphipods are important prey species for juvenile salmon migrating in the Snake/Columbia Rivers, but in areas in Lower Granite without amphipods, a high percentage of juvenile salmon were found with empty stomachs (Muir and Coley 1996). This suggests that juvenile salmon do not readily switch to other prey such as the abundant oligochaetes in the absence of preferred food items such as the amphipods. Outmigration is a time of high metabolic requirements for juvenile salmon and the absence of food for perhaps 1 –3 weeks may reduce their growth, which in turn may reduce their chances of survival.

Benthic invertebrates should be sampled from Lower Granite Reservoir in a generally similar spatial arrangement as the caged bivalve and invertebrate residue analyses. Selection of a meaningful reference condition will be a key part of the study design, since LGR is a complex environment and no ideal reference sites are likely possible due to hydrologic and morphologic differences between locations on the reservoir. Several reference sites may be useful. For example, sites in Little Goose Reservoir may be more hydrologically or morphologically similar to sites downstream of Potlatch than are sites upstream under the influence of the Snake River sediment loads. Still, upstream reference sites are customary in benthic monitoring on river systems, so an upstream reference site[s] would be desirable.

Sampling methods would probably use a Ponar type dredge or coring device. Environment Canada's pulp and paper effluent monitoring guidance provides useful information on design of benthic monitoring sampling program. EPA's environmental monitoring and assessment program (EMAP) also has detailed method manuals for sampling benthic macroinvertebrates in lakes (Baker et al. 1997; Environment Canada 1998). Data interpretation will be based on differences in community structure metrics (e.g. species richness, dominance, species habit or feeding guilds, changes in composition) (see Kilgour et al. 2004). Identification of taxa to family level would probably be sufficient, although identification to lower practicable taxonomic levels would provide more information (tribe, genus).

If benthic community alterations are associated with Potlatch effluents through multivariate statistical analyses of environmental factors, the surveys should be followed up with more definitive sediment analyses, such as sediment toxicity testing with the amphipod *Hyalella* and toxicity identification evaluations.

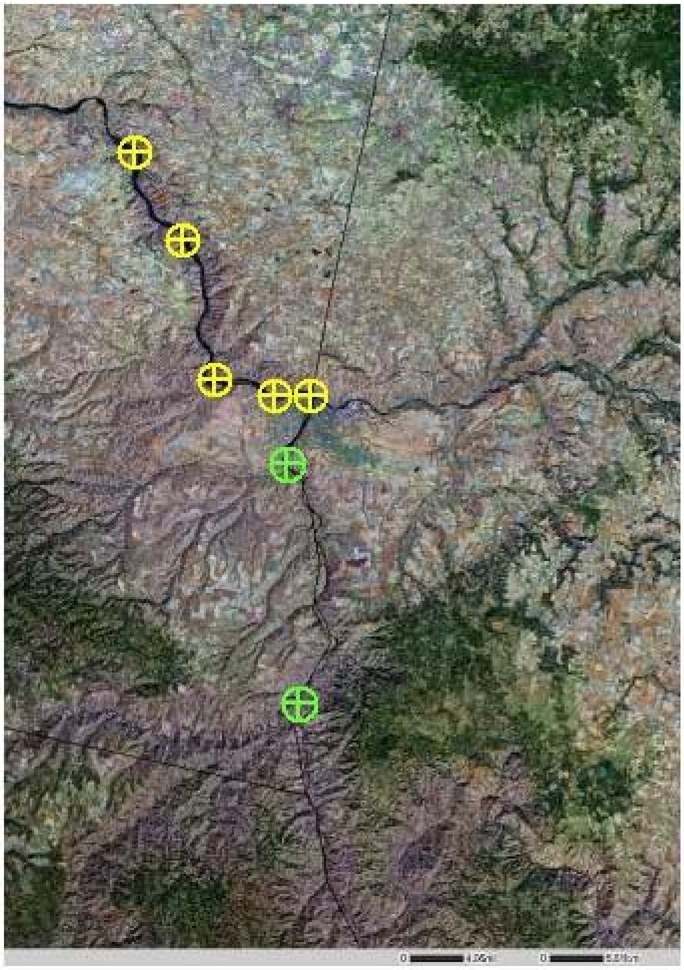

Figure 2. General layout of caged bivalve monitoring test (yellow symbols) and reference (green symbols) stations

Adult Steelhead Effluent Exposure Evaluation

The mixing zone for Potlatch' effluent is located at the key confluence of the Snake and Clearwater Rivers. All Snake River salmon and steelhead populations must pass through this confluence. While some runs of spawning adults are assumed to be present in the area for limited time periods, at least Clearwater River runs of steelhead trout typically hold for 3 – 5 months near the confluence of the Snake and Clearwater rivers before moving upstream (Bjornn et al. 2003). It is not known if these fish are exposed to harmful chemicals from the Potlatch effluent; however, it is a possibility.

The general recommended study design would be to capture adult steelhead before and after potential extended exposure to Potlatch's effluent in the vicinity of the Clearwater and Snake River confluences. The reference fish would be collected from the Lower Granite Dam fish passage facilities as they ascend, around September or October. The test fish would be collected by hook-and-line from the vicinity of the confluence around February or March, after exposure opportunities and before they would be expected to move up to the natal "stream" (raceway). It may be most efficient for the investigators to contract and accompany local professional guides to capture the fish in the confluence vicinity.

Recommended sample sizes are on the order of 3 – 4 samples of five fish each from the Lower Granite fishways, and 15 –20 individual fish from the confluence area.

Tissues would be analyzed for, at a minimum, all contaminants of concern in Table 6 for which tissue benchmarks are available, as well as selected biomarkers of exposure (Table 6,7,11).

The steelhead monitoring survey should be continued until no effect is observed in the steelhead populations exposed to the contaminants released from Potlatch. No effect is determined from comparisons to tissue benchmarks and the dose response curve for the health effects.

Table 9. Seasonal abundance of fish from sampling station nearest Potlatch discharge (Station 5) in 1989 (Bennett et al. 1991)

	Spring (1 April - 30 June)			Summer (1 July – 30 Sep)			Fall (1 Oct- 31 October)		
Rank Order	Species	Number captured	Percent of total (%)	Species	Number captured	Percent of total (%)	Species	Number captured	Percent of total (%)
1	Chinook	2640	66.50	*Lepomis* sp	206	26.21	Largescale sucker	152	19.34
2	Largescale sucker	518	13.05	Largescale sucker	175	22.26	*Lepomis* sp	78	9.92
3	Steelhead	113	2.85	Smallmouth bass	152	19.34	Smallmouth bass	77	9.80
4	Smallmouth bass	46	1.16	White crappie	92	11.70	Yellow perch	29	3.69
5	Chiselmouth	246	6.20	Yellow perch	34	4.33	White crappie	23	2.93
6	Pikeminnow	126	3.17	Black crappie	33	4.20	Pikeminnow	18	2.29
7	White crappie	101	2.54	Pumpkinseed	31	3.94	Black crappie	18	2.29
8	Pumpkinseed	36	0.91	Carp	20	2.54	Pumpkinseed	9	1.15
9	Carp	32	0.81	Pikeminnow	11	1.40	Carp	7	0.89
10	Channel catfish	14	0.35	Channel catfish	9	1.15	Br. Bullhead	5	0.64
11	Yellow perch	59	1.49	Br. Bullhead	8	1.02	Steelhead	4	0.51
12	White sturgeon	0	0.00	Bluegill	5	0.64	Chiselmouth	4	0.51
13	Mountain whitefish	1	0.03	Steelhead	2	0.25	Bridgelip sucker	3	0.38
14	Bluegill (Lepomis)	0	0.00	Bridgelip sucker	2	0.25	Channel catfish	3	0.38
15	Redside shiner	0	0.00	Chiselmouth	1	0.13	Cottus sp.	1	0.13
16	Peamouth	4	0.10	Cottus sp.	1	0.13	White sturgeon	0	0.00
17			0.00	White sturgeon	0	0.00	Chinook	0	0.00
18	Sculpin	1	0.03	Chinook	0	0.00	Peamouth	0	0.00
19				Peamouth	0	0.00	Redside shiner	0	0.00
20				Redside shiner	0	0.00	Bluegill	0	0.00

Table 10. Seasonal abundance of fish from sampling station nearest Potlatch discharge (Station 5) in 1991 (Bennett et al. 1993)									
	Spring (1 April - 30 June)			Summer (1 July – 30 Sep)			Fall (1 Oct- 31 October)		
Rank Order	Species	Number captured	Percent of total (%)	Species	Number captured	Percent of total ()	Species	Number captured	Percent of total (%)
1	Chinook	996	39.59	Smallmouth bass	173	45.29	Largescale sucker	143	37.43
2	Largescale sucker	539	21.42	Pikeminnow	91	23.82	Smallmouth bass	70	18.32
3	Pikeminnow	295	11.72	Largescale sucker	32	8.38	Pikeminnow	63	16.49
4	Rainbow trout	279	11.09	Crappie unk (*Pomoxis* spp)	30	7.85	Lepomis sp	21	5.50
5	Chiselmouth	146	5.80	Pumpkinseed	19	4.97	White crappie	13	3.40
6	Smallmouth bass	131	5.21	Chiselmouth	10	2.62	Pumpkinseed	8	2.09
7	Pumpkinseed	29	1.15	Peamouth	9	2.36	Chiselmouth	7	1.83
8	Bridgelip sucker	16	0.64	Lepomis sp	5	1.31	Br. Bullhead	7	1.83
9	Lepomis sp	12	0.48	Bluegill	5	1.31	Yellow perch	5	1.31
10	White crappie	12	0.48	White crappie	3	0.79	Channel catfish	4	1.05
11	Black crappie	12	0.48	Black crappie	3	0.79	Rainbow trout	3	0.79
12	Peamouth	10	0.40	Bridgelip sucker	1	0.26	Peamouth	3	0.79
13	Yellow perch	10	0.40	White sturgeon	0	0.00	Bridgelip sucker	3	0.79
14	Br. Bullhead	7	0.28	Chinook	0	0.00	Black crappie	3	0.79
15	Carp	5	0.20	Rainbow trout	0	0.00	Chinook	1	0.26
16	Cottus sp.	4	0.16	Carp	0	0.00	Carp	1	0.26
17	Redside shiner	1	0.04	Redside shiner	0	0.00	White sturgeon	0	0.00
18	Channel catfish	1	0.04	Br. Bullhead	0	0.00	Redside shiner	0	0.00
19	Bluegill	1	0.04	Channel catfish	0	0.00	Bluegill	0	0.00
20	White sturgeon	0	0.00	Yellow perch	0	0.00	Crappie unk (*Pomoxis* spp)	0	0.00
				Cottus sp.	0.00		Cottus sp.	0	0.00

Table 11. Candidate fish health measurement endpoints and exposure biomarkers that have been used successfully in BKME monitoring effects studies (Gibbons et al. 1998; Munkittrick et al. 2001; van der Oost et al. 2003)

Measurement Endpoint	Indicators	Expected response to effluents
Energy expenditure	Growth rate	Variable
	Gonad vs. carcass weight	Decrease
	Fecundity	Decrease
	Egg size	Decrease
Energy storage	Condition factor	Decrease
	Liver vs. carcass wt.	Increase
	Lipid storage level	
Survival	Mean age	
	Age distribution	
Biomarkers of chemical exposure	Liver enzymes (e.g. EROD, c Cytochrome P450)	Elevated
	Stress protein HSP70	
Androgenization	Gonopodial development (masculinization)	Increased
	17β-estradiol	Decrease
	Vitellogenin	Increase in males/decrease in females
	Testosterone	Increase
	Androstenedione	Increase

<u>Modified Whole Effluent Toxicity (WET) Monitoring</u>

In order to determine potential toxic effects of the discharge, the proposed final permit requires regular short-term toxicity tests to estimate chronic toxicity of whole effluents from Outfall 001. The test species required for this permit include the cladoceran *Ceriodaphnia dubia* and the fathead minnow *Pimephales promelas*. Regulatory WET tests were developed and are used in conjunction with constituent-by-constituent effluent limitations to address possible interactions or toxicity by unregulated or unknown constituents. Because acute tests of lethality cannot detect more subtle toxicant effects, but long-term true chronic tests are infeasible to use in routine effluent testing, short-term methods for estimating chronic responses were developed by EPA (EPA 1991; Lewis et al. 1994). The 7-day WET tests with fathead minnows focuses on the early life stage of the test species on the assumption that protection of this stage will produce results that would be similar to those derived from full life cycle testing or from the 28-day early-life stage test. The 7-day cladoceran partial life cycle test was developed as an alternative to the 21-day daphnid life-cycle test (Lewis et al. 1994).

The use of progressively more abbreviated assays, focused mostly on early survival and development for regulatory purposes and risk assessment, has important shortcomings, particularly with respect to the ability to assess contaminant effects on reproduction. Specifically, some chemicals such as endocrine-disrupting chemicals elicit effects primarily on reproduction and may not be identified as toxic-using tests focused on early development (Ankley et al. 2001). Methods have been used to address reproductive endpoints with pulp mill effluents and other substances or mixtures for which reproductive effects are a concern (Ankley et al. 2001; EPA 2002; NCASI 1996; 1998; Parrott et al. 2003). Further, some studies that have compared the WET predictions of pulp mill effluent toxicity to instream periphyton, invertebrate, or fish assemblages found that standard WET testing underpredicted the toxicity of pulp mill effluents (Culp et al. 2000; Sarakinos et al. 2000; Sarakinos and Rasmussen 1998).

In 16 quarterly tests of Potlatch effluents, the *Ceriodaphnia* tests were more sensitive than the fathead minnow tests in 14 of16 tests, and equally sensitive in one test, and less sensitive in one test. Thus the 7-day fathead test provided little additional information on WET than did the 7-day Ceriodaphnia test(EPA 2003a)

Based on the literature reports mentioned above and the WET testing results of Potlatch's effluents using standard tests, a change to the previous standard WET testing is warranted. In lieu of continued quarterly testing with the 7-day fathead minnow tests, annual testing with fathead minnows using longer-term tests should be conducted. Initial reviews of EPA (2002) suggest it might be the most sensitive method, however the various methods should be reviewed carefully before testing to select an optimal design.

Food Web Study, Complete Bioaccumulation Study

The conceptual model which is the basis for the bioaccumulation portion of this monitoring plan for exposure and potential effects to anadromous salmonids is:

1) Contaminants are released from the plant effluent through its outfall and as pond seepage;
2) Some contaminants are sorbed to suspended particulates in the effluent,
3) The contaminants which are sorbed to particulates enter the aquatic food chain through direct ingestion or settle onto the substrate where they may be bioavailable to benthic organisms,
4) Contaminated benthic organisms are eaten by forage fish or juvenile salmonids,
5) Exposure of salmonids to contaminants results in elevated tissue residues or biomarkers of exposure (e.g. liver enzymes), and
6) Exposure to contaminants may result in adverse fish health measures such as increased probability of mortality, reduced growth or impaired reproductive success (e.g. measured condition factors or hormone levels).

The bioaccumulation study requires measurement and modeling of contaminants for different trophic levels as well as in sediment and water as described in the previous section and illustrated in Figure 3. The results of this study will reduce the uncertainty in the BAF and BSAF derivations used in the Biological Evaluation. This phase of the monitoring plan should be completed during the first year(s) of the permit.

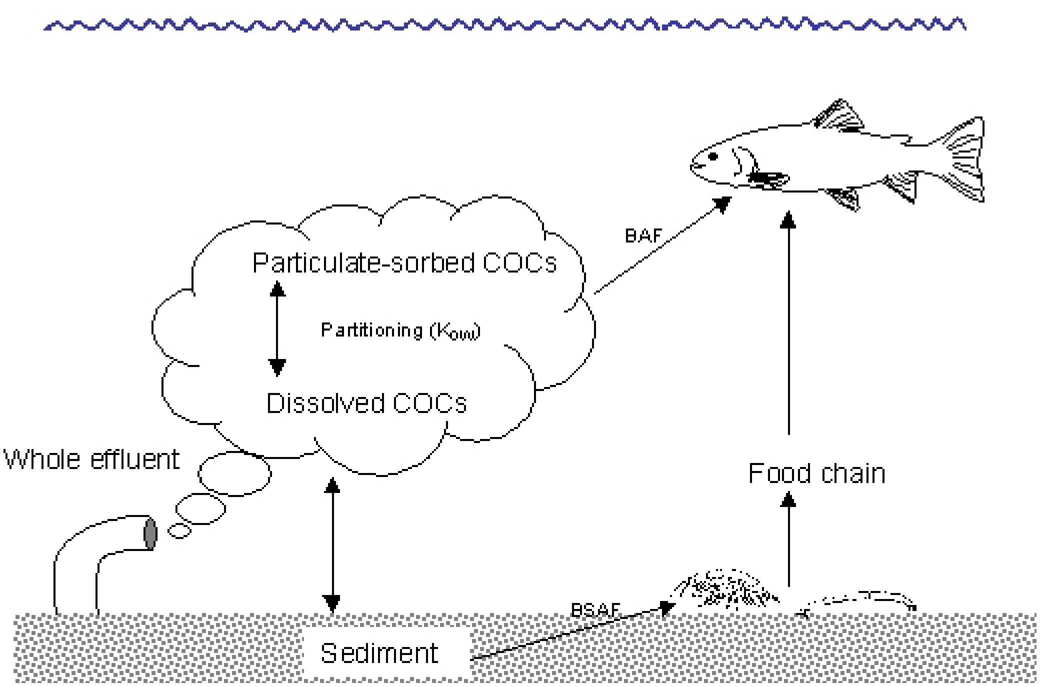

Figure 3. Conceptual model of exposure and effects of pulp and paper effluent to an aquatic ecosystem.

Develop or modify benchmarks for water, sediment, and fish tissue

Benchmark (Table 6) revisions or development will be primarily completed during the first few years of the permit. However, revision or development of benchmarks at any time during the life of the permit may be warranted if new information regarding the toxicity of chemicals of concern becomes available. Benchmarks can be developed by using a combination of literature review, theoretical models, and field observations. The following are examples of methods which were used to derive benchmarks the BE and this plan:

1. Model water concentrations from measured sediment concentrations with partition coefficients and compare these to water concentration benchmarks,
2. Model tissue concentrations based on BSAFs derived for this system, and
3. Critical body residues can be generated for some of the chemicals of concern (chlorophenols, chloroguaiacols, chlorosyringols, and chlorocatechols) and possibly phytosterols.

For some chemicals, we can likely derive sediment and tissue concentrations that we will consider as no effect levels (NOEC). This may be done by modeling water concentrations with sediment partition coefficients or by determining critical body residues, which can be generated for some of the CPC (chlorophenols, chloroguaiacols, chlorosyringols, and chlorocatechols). We already have a dioxin tissue benchmark, which can be applied to fish we collect in the Lower Granite Reservoir. These concentration data will be used to model tissue concentrations in salmonids. This will be accomplished with simple bioaccumulation modeling that the EPA has already established.

Evaluate the likelihood that adverse ecological effects are occurring or may have occurred as a result of release of toxic chemicals from the Potlatch Pulp Mill.

The first level of evaluation is to compare the measured chemical concentrations to benchmarks from the Biological Evaluation, Permit, and Biological Opinion (Table 6, 7). These comparisons are:

1. Compare measured water column concentrations to water column benchmarks
2. Compare sediment concentrations to sediment benchmarks.
3. Compare tissue concentrations to tissue benchmarks.

These measurements of water column concentrations will continue throughout the life of the permit to assure that no effects will be experienced for endangered species. The sediment and tissue chemical measurements will continue as long as they exceed the benchmarks defined in the permit and/or BE and/or BO. The frequency and duration of the measurements which exceed the benchmark will depend on the number of samples that are collected.

In addition to comparing chemical concentrations in water, sediment, and tissue to benchmarks a statistical comparison of upstream and downstream concentrations should be attempted. This may be particularly difficult because of the dynamics of this ecosystem. Conclusions whether concentrations are statistically higher should be based upon hypothesis testing between reference and test sites using sufficient statistical power to detect significant adverse effects, if they are present. As discussed in the section of this monitoring plan which provided an example estimating the number of sediment chemistry replicate samples per station required to detect a 3x difference in sediment contaminant concentrations between stations, four replicates/station are required using the assumptions in the earlier example. This experimental design (assuming all monitoring data are as variable as the measured 4,4'-DDE concentrations in sediment of Lower Granite Reservoir) was based on a statistical significance level (α) of 0.05 and a statistical power ($1 - \beta$) of 0.80. The effect of the minimum detectable difference it is desired to observe and sample variability on the number of samples that need to be collected in the field can be demonstrated by using a different set of assumptions than those mentioned above. For a suggested statistical goal of having sufficient replication to detect a maximum change of 25% (i.e. 1.25x increase in concentration) with $\alpha = 0.1$ and $1 - \beta = 0.9$, a sample size of 226 replicates/station is required.

As discussed earlier, EPA strongly recommends that Potlatch retain a statistician to help with the experimental design of the various study tasks. For all monitoring tasks performed under this monitoring plan, the actual statistical power of the test achieved should be reported along with the results.

For contaminants where no tissue concentration benchmark is available, only upstream-downstream statistical comparisons of tissue residents and health parameters may be made.

Biological responses are needed as additional lines of evidence to reduce the uncertainty associated with chemical measurements and to provide direct observations of adverse effects to endangered species. Biological responses integrate the effects of all chemicals. These tests provide evidence for the effects of multiple chemicals (WET) and multiple stressors (caged bivalve) that are not addressed by comparing chemical concentrations for individual benchmarks. The fish tissue health studies are another direct measure of the effect of the effluent on the endangered species that integrate multiple chemical and multiple stressor effects. Biological responses are also not limited by chemical detection errors.

If sufficient physical, chemical, and biological monitoring and assessment has been conducted (1 to 5 years depending on the test (see details in previous sections) to demonstrate (through models and measurements) that no adverse effects are likely, then the frequency of sampling could be decreased. If adverse effects are found or predicted, a reduction of chemical concentrations to no effect levels must be initiated.

A spatial and temporal trend analysis of concentrations in the ambient environment (fish tissue and sediments) should also be conducted. This trend analysis will involve several years of monitoring at multiple locations. The importance of this phase of the plan is to demonstrate that reductions of effluent loading are in fact reducing environmental exposures.

The duration and frequency of sampling and analysis as well as decision points in the monitoring and assessment plan were generally outlined in Table 2

Work Plan and Quality Assurance Project Plan Requirements.

Potlatch will prepare a work plan describing in detail how the monitoring plan tasks described in this monitoring plan will be performed. The work plan will be submitted to EPA for review and approved by EPA within 180 days of the reissuance of the NPDES permit, and prior to the start of monitoring of the ESA species studies. A quality assurance project plan (QAPP) for all monitoring required by this permit must be prepared as part of the project work plan. The QAPP must be designed to assist in planning for the collection and analysis of effluent and receiving water samples in support of the permit and in explaining data anomalies when they occur. Throughout all sample collection and analysis activities EPA-approved QA/QC and chain-of-custody procedures described in *Requirements for Quality Assurance Project Plans* (EPA/QA/R-5) *and Guidance for Quality Assurance Project Plans* (EPA/QA/G-5) must be used. All appropriate required water monitoring must be provided in the QAPP including:

a. Sample locations (map and physical description, which includes station identification number, latitude, and longitude);
b. Sample frequency;
c. Sample handling, storage, transport, and Chain-of-Custody procedures;
d. Parameters, preparation and analysis methods, detection and quantitation limits for each parameter, and volume of sample required for each analyte in each medium (i.e., water);
e. Type and number of QC samples, spikes and replicates required for analysis (for precision accuracy);
f. Retention or holding time;
g. QA/QC procedures for test methods;
h. Number of samples collected;
i. Volume of each sample collected;
j. Field test blanks;
k. Organizational responsibilities - who is responsible for QA/QC activities (i.e., who takes samples, who reviews the data analysis, etc.); and
l. Qualification and training of personnel conducting QA/QC activities; and
m. Name(s), address(es), and telephone number(s) of the laboratories used or proposed.

The QAPP must be current and applicable. It must amended whenever there is a modification in the sample collection, sample analysis, or conditions or requirements. An annual report summarizing the results of the water column monitoring must include:

a. a discussion of sampling and laboratory methods, including quality assurance/quality control (QA/QC), data handling, and the results of the study;
b. dates of sample collection and analyses;
c. analysis methods used and MDLs; and

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Appendix 6.

NOAA Fisheries' addendum to the March 1, 2004 Monitoring and Assessment Plan

Appendix 6: Monitoring the extent of take of ESA listed salmonids: addendum to the Monitoring and Assessment Plan included in the Biological Opinion

This appendix provides additional information on how NOAA Fisheries expects to interpret results of monitoring and assessment implemented as reasonable and prudent measures under this biological opinion. It also includes guidance for conducting benthic macroinvertebrate surveys in relation to the Potlatch outfall.

EPA provided a "monitoring and assessment plan for exposure and effects of effluents from the Potlatch Pulp and Paper Mill to ESA listed salmonids and their habitats." The plan, which is subtitled "Draft Monitoring and Assessment Plan, March 1, 2004," was included in EPA's March 2, 2004 amendments to the Biological Evaluation (BE) for the Potlatch Mill, and is called "conservation measure #12" of the BE. The monitoring and assessment plan is part of the reasonable and prudent measures to reduce take of listed salmonids, and it is appended to this BO as Appendix 5. The plan was developed with the involvement of NOAA Fisheries and Potlatch, however, since EPA was in the lead for assembling the plan, for convenience it is referred to here as "EPA's" monitoring and assessment plan.

EPA's monitoring and assessment plan provided a listing of the types of studies EPA believed were necessary to further characterize the effects that Potlatch's NPDES discharge permit will likely have on endangered and listed species and the environment by conducting studies that address the uncertainties described in EPA's biological assessment. EPA's plan included a recommended approach and sequence for performing the various listed tasks. The tasks were generally grouped into "Tier 1" tasks that were expected to be completed in 2-3 years and "Tier 2" tasks which were contingent on results of Tier 1 tasks. Potlatch proposed a different approach to monitoring and assessment (Ginsberg 2004). EPA's plan can be described as a "strength of evidence" approach to monitoring and assessment, where different types of physical, biological, and chemical information would be collected and analyzed. Potlatch's plan can be described as a more "sequential" or linear approach with monitoring initially focused on chemical analyses of effluents, and several decisions to collect additional lines of evidence would be based upon the results of the previous analysis. Depending on results, the additional lines of evidence would be collected over about 7 phases (Ginsberg 2004).

<u>Evaluating the Monitoring Information for "Take"</u>

NOAA supports the "strength of evidence" approach to monitoring and assessing potential effects of Potlatch's discharges to ESA listed salmonids, their prey, and their habitats. NOAA recognizes that within the "strength of evidence" approach there are alternative ways of gathering necessary information, and acknowledges that as more detailed study plans are developed, there will be refinements to the list of monitoring tasks, their scale, and the sequencing of which tasks are dependent upon the outcome of a previous task. While acknowledging that flexibility, NOAA considers four minimum categories of information necessary in the monitoring of take: 1) chemical contaminants in sediment, 2) chemical contaminants in prey, i.e. invertebrate, 3) prey quantity and quality, i.e. benthic macroinvertebrate community evaluations, and 4) chemical contaminants in fish. In some cases these lines of information can be gathered directly for listed salmonids, and in other cases the use of surrogates may be more efficient (Table A6-1). Valid data for at least one line of evidence within each category is needed. Using a similar "tier" terminology as the EPA monitoring and assessment plan, at least one study in each category needs to be completed as a "Tier 1" study for monitoring the extent of "take," other studies could be appropriate dependent upon the results of the initial studies within a category.

Table A6-1. Minimum categories of information for monitoring effects of Potlatch discharges to listed salmonids

Category	Examples of acceptable study elements
1. Sediment chemical contamination	Sediment chemistry surveys
2. Invertebrate tissue chemical residues (prey chemical quality)	a) Caged bivalve study b) Chemical analyses of field collected invertebrates
3. Invertebrate community analyses	Benthic macroinvertebrate surveys
4. Fish tissue chemical residues	a) Surrogate analysis - resident fish monitoring b) Direct analysis - juvenile salmon monitoring c) Direct analysis - adult steelhead monitoring

To assess whether the effluent discharges are causing "take" of listed species, NOAA Fisheries expects to use the factors in Table A6-2 as a guide. These simple guidelines do not (and probably cannot) cover every possible monitoring outcome, however they provide some framework for interpreting data results prior to their collection.

A goal in environmental monitoring studies such as these for Potlatch effluents, is to detect the influences of the activities of concern (effluents in this case) in a complex and variable environment. This is a well recognized challenge in environmental pollution monitoring (see for example Gilbert 1987; NRC 1990; Suter et al. 2002, and the studies referenced in EPA's monitoring plan). Potlatch has argued that it should not be responsible for conducting biological or chemical monitoring of the receiving environment because conditions are likely influenced by many human-caused or naturally occuring factors that are unrelated to their discharge (Ginsberg 2004).

NOAA rejects that argument because we believe that well designed study plans should provide information necessary to make inferences about likely causes and effects. The Snake River/Lower Granite Reservoir receiving environment is certainly complex, but the problem of monitoring complex aquatic environments is not unique to Potlatch nor insurmountable with good faith efforts by people who are knowledgeable in subject of environmental monitoring and assessment.

Table A6-2. Monitoring elements to evaluate take from sediment deposition or contamination

Parameter	Benchmark
Surficial sediment chemistry	Sample according to Appendix 5, if >95% of sample results less than sediment benchmarks listed in Table 9 (Benchmarks for pulp mill chemicals), there is no take.
Invertebrate tissue chemistry	If concentrations downstream of the discharges are not higher than upstream concentrations, there is no take. If downstream concentrations are higher, then take may be present unless invertebrate and fish tissue concentrations are both less than the benchmarks in Table 9. If a concentration gradient is present for chemicals for which no benchmarks are given in Table 9, then further interpretation may be needed to estimate benchmarks for these chemicals
Benthic macroinvertebrate communities	Sample nearshore habitats within area predicted to be affected by BKME discharges (Figure A6-1). If densities of preferred salmonid prey taxa (e.g. chironomids, amphipods) are not statistically lower at sites downstream of the outfall, there is no take. If they are lower, and if environmental variables other than Potlatch effluents do not explain the differences, there may be take.
Fish tissue concentrations	If >95% of sample results less than fish tissue benchmarks listed in Table 9 "Benchmarks for pulp mill chemicals", there is no take. Otherwise, if initial sampling was using resident fish as surrogates for salmonids, complete studies of fish tissue using salmonids (adult steelhead and juvenile salmon). If valid information is available for both surrogates for salmonids (resident fish) and direct information with salmonids, the salmonid data will be given greater emphasis.

NOAA Fisheries believes that objective judgements whether any observed apparent chemical exposure should be linked to Potlatch may be facilitated through organizing the information according to associative criteria. Table A6-3 and other examples from Suter et al. (2002) and their companion articles suggest formats for organizing complex (and potentially conflicting) monitoring data for a lines-of-evidence interpretation.

Table A6-3. Types of association between measurements of exposure and effects among site data and evidence that may be derived from each. From Suter et al. (2002)

Type of Association	Example evidence
Spatial co-occurrence	Effects are occurring at same place as exposure.
	Effects do not occur where there is no exposure
	Effects occur downstream of a source.
	Effects do not occur upstream of a source.
Spatial gradient	Effects decline as exposure declines over space.
Temporal relationship	Exposure precedes effects in time.
	Effects are occurring simultaneously with exposure (allowing for lags in response and recovery).
	Intermittent sources are associated with intermittent exposure and effects.
Temporal gradient	Effects increase or decline as exposure increases or declines over time.

Additional information for designing benthic macroinvertebrate sampling and assessment study plan

Benthic macroinvertebrate monitoring is widely used to evaluate water pollution effects, such as those from effluent discharges (Rosenberg and Resh 1993). However, many other factors are important in structuring benthic communities, and the study plan needs to be designed to control for or at least measure them potentially confounding factors. Thus candidate benthic macroinvertebrate community monitoring sites need to be carefully selected based on pre-sampling reconnaissance.

For community monitoring to be informative in detecting potential influences of discharge on the communities, it is important for sites to be as closely matched as possible for abiotic factors that influence benthic invertebrate structure. These include depth, velocity, substrate grain size, and probably slope. Approximate locations of candidate sites are illustrated in the accompanying figure. Sampling stations should be targeted towards nearshore habitats on the south shore of Lower Granite Reservoir between RM 143 and 131, to correspond with predicted influence of BKME plumes and upstream reservoir reference sites.

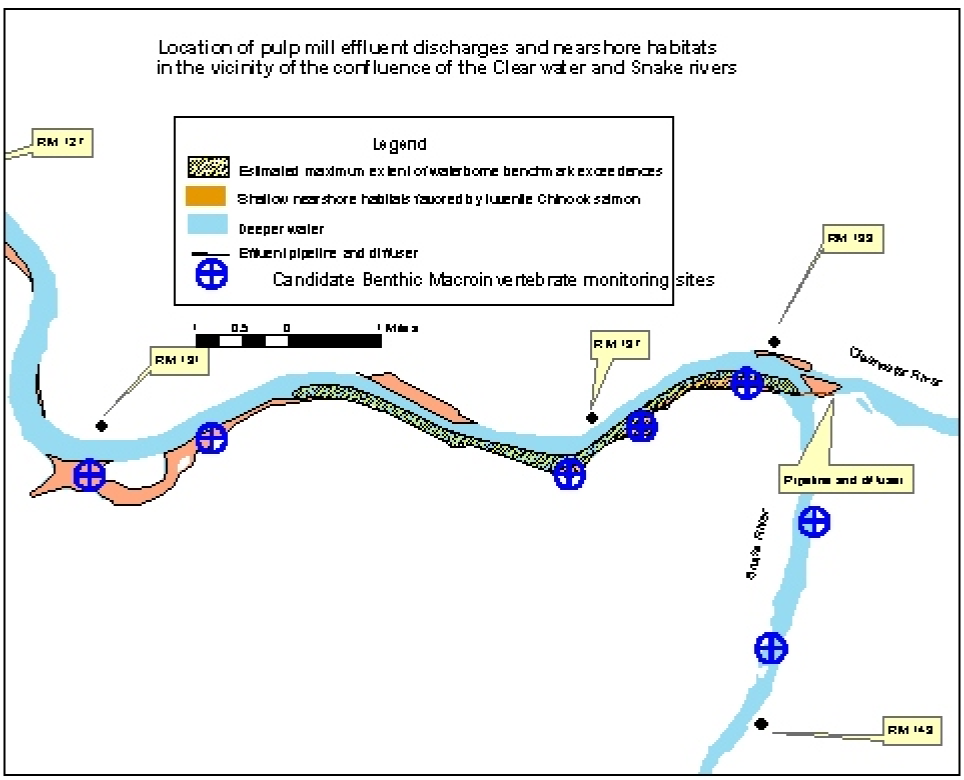

Figure A6-1. Suggested distribution of candidate benthic macroinvertebrate monitoring locations

Taxonomic enumeration should be at least as detailed as that conducted for the Potlatch ambient sediment monitoring program. At least five replicates need to be sampled separately at each site, to enable statistical comparisons between sites. Candidate interpretive metrics such as total taxa richness, densities of taxa preferentially preyed upon by juvenile salmonids (e.g. chironomids, amphipods), Jaccard or other measure of similarity between sites, dominance of three most abundant taxa should be reported. Final metrics to be calculated and reported should be selected in consultation with NOAA. Field surveys of invertebrate communities which are influenced by multiple environmental variables are sometimes best analyzed using multivariate techniques (e.g. Jones et al. 1999; Sibley et al. 2000, Maret et al. 2002).

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Appendix 7

Fish Capture and Relocation

Appendix 7

Fish Capture and Relocation

Monitoring may involve handling of listed salmonids during fish capture. Direct and delayed mortality of Snake River spring/summer chinook salmon and steelhead juveniles is likely to occur from capture and relocation stress during monitoring.

Fish Capture

1. To implement term and condition 3.b under monitoring techniques, the Environmental Protection Aency (EPA) shall ensure that fish capture activities employ the following techniques:

    a. If the fish capture aspect of monitoring requires the use of seine equipment, it must be accomplished as follows:

        (1) Seining will be conducted by, or under the supervision of a fishery biologist experienced in such efforts. Staff working with the seining operation must have the necessary knowledge, skills, and abilities to ensure the safe handling of all ESA-listed fish.

        (2) The ESA-listed fish must be handled with extreme care and kept in water to the maximum extent possible during seining and transfer procedures. The transfer of ESA-listed fish must be conducted using a sanctuary net that holds water during transfer, whenever appropriate, to prevent the added stress of an out-of-water transfer.

        (3) The ESA seined fish must be released as near as possible to capture sites.

        (4) The EPA shall ensure that the transfer of any ESA-listed fish to third parties other than NOAA Fisheries personnel receives prior approval from NOAA Fisheries.

        (5) The EPA shall ensure that any other Federal, state, and local permits and authorizations necessary for the conduct of the seining activities will be obtained prior to project seining activity.

        (6) The EPA must allow NOAA Fisheries or its designated representative to accompany field personnel during the seining activity, and allow such representative to inspect the seining records and facilities.

(7) A description of any seine and release effort will be included in a post-project report, including the name and address of the supervisory fishery biologist, methods used to capture, the means of fish removal, the number of fish removed by species, the condition of all fish released, and any incidence of observed injury or mortality.

b. If the fish capture aspect of this project requires the use of electrofishing equipment, it must be accomplished as described in the NMFS electrofishing guidelines[1].

Reporting fish monitoring results

2. To implement term and condition 3.b under reporting, the EPA shall ensure that:

a. An annual monitoring report that describes the EPA's success meeting its ESA obligations is submitted to NOAA Fisheries by January 15 of each year. This report will consist of the following information:

(1) Project identification.

(a) Project name,

(b) starting and ending dates of work completed for this project,

(c) the EPA contact person.

(2) Fish Capture. All monitoring resulting in fish capture must include a report of fish rescue and salvage activity including:

(a) The name and address of the supervisory fish biologist,

(b) the means of fish capture,

(c) the number of fish removed by species,

(d) the location and condition of all fish released, and

(e) any incidence of observed injury or mortality.

(f) Submit monitoring reports to:

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[1]NMFS (National Marine Fisheries Service), *Backpack Electrofishing Guidelines* (December 1998) (http://www.nwr.noaa.gov/1salmon/salmesa/pubs/electrog.pdf).

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b. If a dead, injured, or sick endangered or threatened species specimen is found, notify the NOAA Fisheries' Law Enforcement Office, at the Boise Field Office, 10215 W. Emerald, Suite 180, Boise, Idaho 83704; phone: 208/321-2956. Care must be taken in handling sick or injured specimens to ensure effective treatment, and care dead specimens must be carefully handled to preserve biological material in the best possible state for later analysis of cause of death. The finder must also carry out any instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.